

CEII

Anderson Dam Seismic Retrofit Project Construction Sequencing Plan Technical Memorandum



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SANTA CLARA VALLEY WATER DISTRICT
Anderson Dam Seismic Retrofit Project

Project No. 91864005

CONSTRUCTION SEQUENCING PLAN

Technical Memorandum

VERSION #2

Prepared By:

ADSRP DESIGN TEAM



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SANTA CLARA VALLEY WATER DISTRICT
Anderson Dam Seismic Retrofit Project

SCVWD Project No. 91864005
SCVWD Agreement No. A3676A
URS PROJECT No. 26818791

CONSTRUCTION SEQUENCING PLAN

Technical Memorandum

5/28/2021, VERSION #2

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This Technical Memorandum has been prepared under the direct supervision of the undersigned, who hereby certifies that he is a Registered Civil Engineer in the State of California



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ACRONYMS AND ABBREVIATIONS

ADSRP	Anderson Dam Seismic Retrofit Project
ADTP	Anderson Dam Tunnel Project
BHBA	Basalt Hill Borrow Area
CSP	Construction Sequencing Plan
cfs	Cubic feet per second
cy	Cubic yard(s)
cy/hr	Cubic yards per hour
District	Santa Clara Valley Water District
HLOW	High Level Outlet Works
ecy	Embankment cubic yard(s)
bcy	Bank cubic yard(s)
kcy	Thousand cubic yard(s)
LLOW	Low Level Outlet Works
MDHTM	Material Development and Handling Technical Memorandum
NTP	Notice to Proceed
PGBP	Packwood Gravel Borrow Pit
TM	Technical Memorandum
RDA	Reservoir Disposal Area
SA-B	Stockpile Area B
SA-C	Stockpile Area C
SA-D	Stockpile Area D
SA-E	Stockpile Area E
SA-H	Stockpile Area H
SA-K	Stockpile Area K
SA-L	Stockpile Area L

1 INTRODUCTION

The Anderson Dam Seismic Retrofit Project (ADSRP) requires a Construction Sequencing Plan (CSP) to understand what tasks are needed for construction of each project component, and to assess how they interrelate during the total duration of about 7 years required for construction. This CSP takes into account several changes to the project including the new reservoir restriction level of El. 488 and completion of the planned Anderson Dam Tunnel Project (ADTP) that will help the District maintain the reservoir level at El. 488.

All elevations in this Technical Memorandum (TM) reference the North American Vertical Datum of 1988.

1.1 PURPOSE AND SCOPE

The purpose of this technical memorandum is to establish the construction sequencing and duration needed to meet the requirements for completing the ADSRP, based on the revised 60 percent design.

The major changes from the 60 percent design (URS, 2018a) include the following:

- Construction of a Stage 1 diversion system during the ADTP that will require modifications at the upstream end during ADSRP to complete the Stage 2 diversion system that will be needed for diversion following emptying of the reservoir (URS, 2020a).
- Increase in the number of construction seasons to excavate the existing dam and construct the new dam from 3 to 5 in order to achieve an acceptable likelihood of completion of critical milestones for interim dam levels (URS, 2019, 2021a).
- Reconstruction of the spillway to incorporate modern spillway standards (URS, 2018b).
- Reconfiguration of the low-level outlet works (LLOW) to increase the size of the low-level bypass pipe from 12-inches to 33-inches (URS, 2020b).
- Reconfiguration of stockpiling of excavated dam materials downstream of the dam to upstream in the reservoir area to the degree feasible.

The scope of work is described in the Scope of Services of the original contract, and includes the following tasks:

- Identify the Consultant's intended construction sequencing to meet project requirements, including support excavations for foundation, abutments, outlet works, stockpiling, embankment construction, and other constructability considerations, including maintaining the required reservoir levels and service.
- Use the CSP, as needed, to guide the detailed design.
- Update the CSP as the design is refined.

1.2 ORGANIZATION OF TECHNICAL MEMORANDUM

After this introduction, this TM is organized as follows:

1. Section 2 – Describes the major assumptions used to develop the CSP.
2. Section 3 – Describes the construction sequencing.
3. Section 4 – Describes the main construction risks.
4. Section 5 – Presents limitations of the TM.
5. Section 6 – Lists the references cited.

2 ASSUMPTIONS FOR CSP

This section describes the assumptions made in the development of the sequencing of construction for the revised 60 percent design.

2.1 GENERAL ASSUMPTIONS

The following general assumptions are used in the CSP:

- Earthwork on the existing dam and the replacement dam is assumed to be two 10-hour shifts (with a 0.5-hour lunch) per day (likely 6:00 am to 4:30 pm, and from 6:00 pm to 4:30 am), 5 days per week. Unless otherwise noted, Saturdays are reserved for equipment maintenance and to provide for catch-up work, if needed.
- Earthwork on the existing dam and the replacement dam is assumed to occur between April 15 and November 15, with extension pending weather and permit requirements.
- In-channel work downstream of the dam is assumed to occur between April 15 and October 15, but could be extended pending weather and permit requirements.
- The ADTP outlet works will be used to start dewatering the reservoir about April 15 of the year that excavation of the existing embankment begins (Year 2).
- The ADSRP diversion system will be completed during Year 2 prior to the precipitation season so that winter flows can be safely diverted around the site with the Stage 1a, Stage 1b, Stage 2b, and Stage 3a interim dams in place.
- Tunnel excavation and support production rates are assumed to be average rates for work being performed 24 hours per day (two 12-hour shifts), 6 days per week.
- All other activities are assumed to be 1 shift per day (likely 6:00 am to 4:00 pm) 5 days per week unless otherwise noted. Saturdays are reserved for equipment maintenance and to provide for catch-up work, if needed.

2.2 STAGING, TEMPORARY STOCKPILE, AND DISPOSAL AREAS

Staging, temporary stockpile, and disposal areas are discussed in the MDHTM (URS 2021a) and shown on Figure 2-1. The MDHTM presents the recommended stockpiling approach for temporarily storing materials excavated from the existing dam for reuse in the replacement dam. The recommended approach primarily uses:

- Upstream Stockpile Area L (SA-L) and upstream Stockpile Area H (SA-H) for shell materials (Zone 1/4) excavated during Year 2 and Year 3 for reuse in Year 5.
- Downstream Stockpile Area E (SA-E) for a portion of core materials (Zone 2/3) excavated during Year 2 for reuse in Year 6.
- Upstream Stockpile Area K (SA-K) for core materials (Zone 2/3) excavated during Year 2 and Year 3 for reuse in Year 5 and Year 6. The southern half of SA-K would be used for this purpose.
- Upstream Stockpile Area K (SA-K) for transition materials (Zone 5a) screened from shell materials excavated from the dam during Year 2 for reuse in Year 4, Year 5, and Year 6. A

portion of the northern half of SA-K would be used for this purpose. The other portion of the northern half of SA-K would be used for lower fine fill (LFF) materials (Zone 1/4) excavated during Year 2 and Year 3 for reuse in Year 5 and Year 6 as downstream shell material.

- Upstream Stockpile Area C (SA-C) for shell materials (Zone 1/4) excavated during Year 4 for reuse later in Year 4. SA-C would also be the location for a grizzly screening operation to produce transition (Zone 5a) materials from excavated shell materials during Year 2.
- Stockpile Area D (SA-D), which overlies the Reservoir Disposal Area (RDA), for core materials excavated during Year 4 for reuse later in Year 4.
- The eastern portion of Staging Area 1 for imported filter and drain materials during Year 4, Year 5, and Year 6.

Table 2-1 is a summary of the assumed usage of the staging and stockpile areas in this CSP.

Table 2-1. Assumed Use of Staging and Stockpile Areas in CSP

ACTIVITY	YEAR 1	YEAR 2-3	YEAR 4	YEAR 5-6	YEAR 7
Staging Area 1 (West)	Offices, parking	Offices, parking	Offices, parking	Offices, parking	Offices, parking, restore ¹
Staging Area 1 (East)	Laydown	Core drying	Filter, drain	Filter, drain	Restore
Staging Area 2	Laydown	Laydown	Laydown	Laydown	Restore
Staging Area 3	Fuel Storage Equipment parking	Fuel Storage Equipment parking	Fuel Storage Equipment parking	Fuel Storage Equipment parking	Restore
Staging Area 4	Laydown	Laydown	Laydown	Laydown	Restore
Staging Area 5	Parking	Parking	Parking	Parking	Parking
SA-B	ADTP material	Shell	Shell	Shell	Restore
SA-C	Develop access	Screen transition	Shell	Unavailable	Unavailable
RDA and SA-D	Unavailable	Disposal placed to build base of SA-D	Core and disposal	Disposal	Unavailable
SA-E	Unavailable	Core	Core	Core	Restore
SA-H	Develop access	Shell	Shell	Shell	Unavailable
SA-K (South)	Develop access	Core	Core	Core	Unavailable
SA-K (North)	Develop access	Transition LFF for shell	Transition LFF for shell	Transition LFF for shell	Unavailable
SA-L	Develop access	Shell	Shell	Shell	Unavailable

Materials that were excavated during ADTP and placed in Stockpile Area B would be disposed in the cofferdam and RDA in Year 2. Excavated materials that cannot be reused would be disposed in three locations in the reservoir area: the cofferdam, the RDA, and the access road to the Packwood Gravel Borrow Pit (PGBP). The RDA would be used for the majority of excavated materials that are not able to be reused.

2.3 ACCESS ROADS

Access roads for construction of ADSRP, including existing local roads that would be used to reach the main project area and temporary on-site access roads, are discussed in the following sections.

2.3.1 Local Access Roads

The main project area can be accessed from three locations on Cochrane Road: at the western end of the Live Oak Picnic Area (Staging Area 1); at the current entrance to Toyon Park at the toe of the dam; and at the entrance to Anderson Lake County Park (intersection of Coyote Road and Cochrane Road), as shown on Figure 2-1. Cochrane Road is anticipated to be open to through traffic throughout construction, except for three short-term periods when the portion of Cochrane Road at the dam would be closed as follows:

- An estimated 12 weeks during installation of the tie-back wall that will allow excavation to the dam foundation level adjacent to the road (during Year 3).
- An estimated 2 weeks during tying-in of the Main Avenue Pipeline from Cochrane Road to the LLOW outlet structure (during Year 5 or Year 6).
- An estimated 4 weeks during construction of the driveway entrance to the downstream toe of the new dam, which includes improvements to Cochrane Road on either side of the new driveway (during Year 5 or Year 6).

Project personnel, mobilization of equipment, and importation of materials and supplies would access the project area using Cochrane Road from Highway 101 directly to Staging Area 1 or less likely to the dam crest area via Peet Road, Half Road, Cochrane Road, and Coyote Road. Construction workers that would park in Staging Area 5 would access that staging area via Hill Road and East Dunne Road from Highway 101. The construction workers would be bused about 2.5 miles to the project area via Hill Road, East Main Avenue, and Cochrane Road.

2.3.2 On-Site Access Roads

Access roads that would be constructed during Year 1 would include:

1. Possible widening of a cut-and-fill haul road constructed during ADTP on the existing slope of the dam from Staging Area 4 at the toe of the dam to Coyote Road (see Figure 2-2);
2. Access roads from the dam to Staging Area 1 and SA-E—one from the toe of the dam, and one along the Anderson Dam Trail alignment (see Figures 2-1 and 2-2).
3. An access road from the left crest of the dam, across the upstream slope of the dam, and northward along the west rim of the reservoir to Stockpile Areas SA-H and SA-L (See Figures 2-1 and 2-3).

4. An access road from the bottom of the boat ramp southward along the west rim of the reservoir to Stockpile Areas SA-D and SA-K (see Figures 2-1 and 2-3).

The haul road on the downstream slope of the dam would provide access from Staging Area 4 to the left crest of the dam via Coyote Road. This road starts at the right-side toe of the dam and climbs the downstream slope at a 10 to 12 percent grade until it connects with the lowermost bench (about Elevation 460 feet), and then continues to Coyote Road.

The access roads from the dam to Staging Area 1 and SA-E includes two water crossings consisting of one 150-foot-long bridge, and an approximately 250-foot-long dike, as shown on Figure 2-2. For the CSP, the bridge is envisioned to be a contractor-designed, prefabricated, single-span steel bridge supported on seat-type abutments founded on precast concrete-driven piles or cast-in-place piers. The bottom of the bridge would be required to have a minimum clearance of 1 foot above the water level for releases of 4,000 cubic feet per second (cfs) from the diversion system. The dike would be constructed in Year 2 after the reservoir has been lowered and the existing outlet works are no longer operable. The dike would create a ponded area to the east of the dike that will be used as part of the stormwater collection and water treatment system. The conceptual access roads would be surfaced with aggregate base.

Access roads in the vicinity of the dam at the start of Stage 1a excavation are shown on Figure 2-3. During excavation of the embankment, haul trucks carrying core material to Staging Area 1 for moisture conditioning using the upper 10 percent haul road on the downstream slope of the dam to Staging Area 1. Excavated shell materials would be hauled to SA-C for grizzly screening to produce transition material or to SA-L using the haul road on the upstream slope of the dam. The boat ramp and the upper haul road on the left abutment would be used to move material stockpiled in SA-B during ADTP and waste materials excavated from the dam foundation to the RDA. The boat ramp and upper haul road would also be used to haul core material to SA-K (south) for moisture conditioning and stockpiling. The upper 10 percent haul road would be used for hauling core materials until about the end of July of Year 2, when stockpiling of 100,000 ecy of core materials in SA-E is completed.

Access roads in the vicinity of the dam at the end of Stage 1a excavation and the start of Stage 1b excavation are shown on Figure 2-4. Excavated shell materials would be hauled to SA-H and SA-L using the haul road on the upstream slope of the Stage 1a interim dam. Excavated core material would be hauled to SA-K (south) and waste material excavated from the dam foundation would be hauled to the RDA using a series of cut-and-fill haul roads graded into the left abutment along alignments similar to those shown Figure 2-4. Access to the dam excavation grade from the downstream would continue to use the upper 10 percent haul road on the downstream slope until the downstream shell is at about Elevation 500. From Elevation 500 feet to the base of the Stage 1b excavation, the lower 10 percent haul road on the downstream slope would provide access to the dam from downstream. Haul roads would be constructed into the upstream and downstream slopes of the Stage 1b interim dam as the excavation progresses.

Access roads in the vicinity of the dam at the end of Stage 1b excavation and the start of Stage 2a excavation are shown on Figure 2-5. Excavated shell materials would be hauled to SA-C using a haul road on the upstream slope of the Stage 1b interim dam. Once the interim dam excavation drops

below about El. 500, shell materials would be hauled on a roads cut into the left abutment and across the cofferdam to SA-C. Excavated core material would be hauled to SA-D and waste material excavated from the dam foundation would be hauled to the RDA using a series of cut-and-fill haul roads graded into the left abutment along alignments similar to those shown Figure 2-5. Access at the end of Stage 2a excavation and the start of Stage 2b is shown on Figure 2-6.

Access roads that would be used for construction of the new dam would be similar to those described for the excavation in reverse order, except that haul roads on the upstream right abutment that were used for dam excavation would not be feasible due to interference with construction of the HLOW intake structure and sloping intake structure. Thus, shell materials stockpiled in SA-C, SA-H, and SA-L would need to be hauled across the cofferdam and on haul roads excavated into the left abutment to the dam. The end of Stage 2b fill and start of Stage 3a fill would be similar to Figure 2-5, without upstream right abutment access. The end of Stage 3a fill and start of Stage 3b fill would be similar to Figure 2-4, without upstream right abutment access. Finally, the end of Stage 3b fill would be similar to Figure 2-3, without upstream right abutment access. At the end of Stage 3b fill, the access roads on the downstream slope of the dam would be removed.

Access roads could be designed with grades steeper than 10 to 12 percent for short distances or for ramps. The design of the temporary access roads will be by the contractor to meet the requirements for their means and methods.

2.4 BORROW AREAS

Two on-site borrow sources will be used for construction: Basalt Hill Borrow Area (BHBA), and the PGBP as shown on Figure 2-1.

2.4.1 Basalt Hill Borrow Area

Details of the geology and materials in BHBA are described in MDHTM (URS, 2021a). Development of BHBA requires the removal of approximately 367,000 cubic yards (cy) of overburden material¹ to access the estimated 803,000 cy of usable rock for the shell materials. Usage of the overburden material is discussed in Section 2.42. Preparation of BHBA would occur in Year 5, when a portion of the overburden materials would be used to construct the PGBP access road, and the remainder hauled to the RDA.

Due to the high production rates required for embankment construction, the CSP assumes that production and stockpiling of Zone 5 materials would begin in Year 5 for use late in Year 5 and in Year 6. The usable rock would likely require drilling and blasting to increase production. The rock would be excavated using a combination of excavators and bulldozers, loaded into off-highway trucks, and hauled to SA-B, or directly to the dam, when possible. Oversize rock would be removed by dozers with rock rakes as the material is loaded for hauling to the stockpile or dam. Oversize materials will be placed in outer zones of the upstream and downstream shells.

¹ Based on the field investigations, significant quantities of overburden materials suitable for core materials have not been identified.

2.4.2 Packwood Gravel Borrow Pit

Additional Zone 7 core material needed to complete the Stage 3 fill would be produced from the PGBP, which is on the eastern side of the reservoir approximately 3,500 feet from the dam (see Figure 2-1). The PGBP was a primary source for Zone 3 core material of the existing dam. The area has a top elevation of about 575 feet.

Access to the PGBP would be constructed during Year 5 using a portion of the overburden materials stripped from BHBA as described above. The access road would be constructed in the same manner as the cofferdam (URS, 2021b), displacing soft lake sediment as the overburden materials are dumped at the leading edge, and pushed ahead along the access road alignment. After completion of the access road, the approximately 3 feet of sediment overlying the borrow pit would be stripped, a number of exploratory trenches would be excavated to facilitate planning of development of the borrow area, and an area for stockpiling the excavated borrow material would be developed within the limits of the PGBP. Production and stockpiling of Zone 7 materials would begin late in Year 5 for use during Year 6.

2.5 EXCAVATION AND EMBANKMENT CONSTRUCTION

The CSP assumes a fleet of rigid-body off-highway trucks (CAT 773 trucks with an assumed capacity² of about 41 cy) that will be used to haul most of the materials excavated from the dam coupled with more-maneuverable articulated off-highway trucks (CAT 740 trucks with heaped capacity of about 28.5 cy or similar) for a portion of the materials excavated from the dam and dam foundation, for hauling disposal materials for use in the cofferdam fill, the perimeter dikes around the RDA, and the access road to the PGBP. Scrapers were considered, but were not selected, because of the presence of boulders in the Zone 1 and Zone 4 materials that might make the use of scrapers less effective. Scrapers could be effective in Zone 2/3 core materials. However, a mixture of scrapers and off-highway trucks was considered not to provide sufficient flexibility, given periods during Stage 1a and Stage 1b excavation and Stage 3a and Stage 3b fill when only shell materials are being excavated or placed that would require truck haulage.

The CSP assumes that the haul trucks will be loaded using excavators. The rigid body Cat 773 trucks are assumed to be loaded using an excavator equipped with a 12 cy bucket (Komatsu PV1600 or similar). The articulated Cat 740 trucks are assumed to be loaded using an excavator equipped with a 6 cy bucket (Cat 365 FEL or similar). Stage 2a excavation and Stage 2b fill in Year 4 require higher production rates than the other four years. For the Year 4, the CSP assumes the rigid body Cat 773 trucks are loaded using an excavator equipped with a 15 cy bucket (Terex RH120 or similar)

The moisture content of the existing dam core is about 19 to 20 percent; 8 to 10 percent higher than their optimum moisture content of about 10 to 12 percent (URS, 2021c). The high moisture content of the core materials may present trafficability problems for the off-highway trucks. It is anticipated that that bulldozers will excavate and push core materials to large excavators near the upstream or downstream margins of the core for loading into trucks.

² The assumed capacity is midway between the struck capacity and the heaped capacity as specified in Caterpillar brochures.

Moisture conditioning of core materials excavated from the existing dam from about 19 to 20 percent moisture content to 2 to 3 percent above their optimum moisture content is assumed to be performed in the stockpile areas. The time available for drying back the existing core materials is a function of the area available for stockpiling; the rate at which the materials are being excavated; the rate at which the materials are disced; and weather conditions (temperature and humidity). Based on an indicative moisture drying test, the CSP assumes that up to two days³ may be required to dry back the core material to 2 to 3 percent above optimum moisture content. The CSP assumes that core materials will be dried in Staging Area 1 prior to placement in SA-E, whereas in SA-K (South) and SA-D core materials will be able to be dried on one-half of the area while material is being placed on the other half. Drying back of the core is assumed to require placement of the excavated core materials in a 12-inch loose lift and discing each hour during daylight hours for approximately 1.5 to 2 days following placement. In Staging Area 1, a portion of an additional day would be required to move the moisture conditioned core to SA-E. The moisture condition of core materials excavated from the PGBP is similar (URS, 2021c). Drying back of the core material excavated from PGBP would be similar to that described for the existing dam and would occur in a stockpile area in the PGBP.

The production assumptions for Stage 1a, Stage 1b, and Stage 2a excavation and the Stage 2b, Stage 3a, and Stage 3b embankment construction are shown in Table 2-2. The production assumptions are broken down for approximately every 20 feet of excavation and fill by stage in Appendix A.

³ An indicative moisture conditioning test was performed on an approximately 85-pound composite sample of existing core material (URS, 2021d) placed in a clear plastic tub. The starting moisture content of the sample was 20.7%. The sample was tested over two cool (60-75 degrees), humid (84-57%), slightly windy (5-13 mph) days by mixing hourly starting at 7am and ending at 5pm. The weight of the sample and weather conditions were noted hourly. At the end of two days the moisture content of the sample was 13.3%. An additional test is planned for a warmer day that may be more typical of the conditions that are expected during construction.

Table 2-2. Summary of Embankment Excavation and Fill Production Rates

ACTIVITY	QUANTITY (ECY)	AVERAGE PRODUCTION RATE (CY/DAY) ³	TRUCK TRIPS PER DAY ¹	TRUCK FREQUENCY, 20 HOUR WORK DAY (MINUTE) ²	DURATION (WEEKS)
Stage 1a Excavation	1,103,700	10,500	294	4.1	21
Stage 1b Excavation Zone 5 Fill	1,506,700 134,000	12,150	341	3.5	27
Stage 2a Excavation Zone 8/9 (direct import)	969,700 23,700	16,200 474	454 30	2.6 16.0	12 10
Stage 2b Fill Zones 5/7 Zones 5a/8/9 (on-site) Zone 8/9 (direct import)	1,059,800 827,500 112,500 119,800	9,735 1,323 1,409	309 108 88	3.9 5.6 5.5	17
Stage 3a Fill Zones 5/7 Zones 5a/8/9 (on-site) Zone 8/9 (direct import)	1,453,500 1,231,400 139,500 82,600	10,300 1,160 690	290 73 43	4.1 8.2 11.2	24
Stage 3b Fill Zone 5/7 Zones 5a/8/9 (on-site) Zone 8/9 (direct import)	1,476,200 1,183,500 159,700 133,000	10,800 1,450 1,210	303 91 76	4.0 6.6 6.3	22

Notes:

¹ Stage 1a, Stage 1b, and Stage 2a Excavation assume bulking factor of 1.15 and 41 cy loose loads. Stage 2b, Stage 3a, and Stage 3b Fill assume bulking factor of 1.3 and 41 cy loose loads for Zone 5 and Zone 7, and a bulking factor of 1.0 and 16 cy loose loads for Zone 5a, Zone 8, and Zone 9.

² Zone 5a, Zone 8, and Zone 9 assumed to only be placed during a single shift. Zone 8/9 direct import assumed to be limited to 8 hours.

³ Average production rate assumes 90 percent efficiency.

ecy = embankment cubic yard

2.6 TUNNELING

Assumed production rates for tunneling are described below for two major categories of work: excavation and initial support, and installation of the final lining.

2.6.1 Tunnel Excavation and Initial Support

Excavation of the tunnels, which range in size from 14-foot to 24-foot, would be accomplished using a roadheader, excavating either full face before installation of support or potentially in two benches for the 24-foot tunnel in the weaker rock. The average tunnel excavation and support production

rates described below are assumed to be average rates for work being performed 24 hours per day (two 12-hour shifts), 6 days per week. The production rates are also based on the necessary construction activities and anticipated down-days associated with tunnel construction.

- Tunnel production assumptions included the following construction activities:
 - An average 5-foot per round.
 - An excavation rate of 32 cubic yards per hour (cy/hr).
 - 1.5 to 2 hours to install a steel set, including blocking, depending on the tunnel size.
 - A shotcrete application rate of 2.5 cy/hr.
 - 10 hour cure time for shotcrete to reach 1,000 psi prior to the start of excavation for the next round
- For estimation purposes, the general concept for probing work is to incorporate three, 100-foot long probe holes ahead of mining operations along the length of the tunnel. Every three probe-holes are assumed to take a day to complete. This estimation is made based on previous experience with projects of similar size and similar ground conditions.
- For the pre-excavation grouting events, 30-foot long reaches to be grouted would be drilled in a fanning geometry ahead of the excavation. Four working days are estimated per reach. This is only an approximation, because grouting would occur where there is imminent potential for collapse of the excavation; in particular, at areas of high leakage, or flowing water at the excavation face, or as revealed by the probe holes.

The production assumptions and durations for the tunneling are summarized in Table 2-3. The estimated time required for excavating, supporting, and preparing the MTBM launch chamber is based on a chamber being the same size as the LLOT using the same production rates as were used for the low-level outlet tunnel. An estimated 10 weeks would be required to install a jacking frame in the chamber and prepare the MTBM for the lake tap. The average advance rate for micro-tunneling shown in Table 2-3 is based on projects of similar size and in similar ground conditions and considers the likelihood of encountering hard blocks of varying size within the weaker sheared serpentinite matrix along the tunnel alignment.

The total time for road header tunneling is estimated to be 45 weeks. Based on previous experience with projects of similar size and similar ground conditions, a total of 12 workdays lost is assumed through the duration of the portion of tunneling using a road header due to unforeseen problems resulting in a total duration of 47 weeks.

Table 2-3. Summary of Tunneling Production Rates

ACTIVITY	QUANTITY (LF)	EXCAVATION /INITIAL SUPPORT RATE (LF/DAY)	PROBE EVENTS (EACH)	GROUTING EVENTS (EACH)	AVERAGE PRODUCTION RATE (LF/DAY)	DURATION (WEEKS)
Excavate & support 18.0-foot LLOW tunnel (STA 1+07 to 2+65)	158	7.6	1	1	6.1	4.3
Excavate & support 24-foot LLOW tunnel (STA 2+65 to 3+81)	116	6.6	2	1	4.9	3.9
Excavate & support 18.5-foot HLOW tunnel (STA H2+10 to H10+49)	839	7.6	8	2	6.6	21.2
Excavate and support 14- Access Adit tunnel	160	7.6	2	1	5.9	4.5

Notes – 1. Day equals one calendar (two shifts) of production.

2. A 10 percent efficiency factor is added for tunneling accessed through the HLOW Drop Shaft

The production rate for the 85-foot deep HLOW gate shaft having a nominal diameter of 23 feet was assumed to be 5 feet per day resulting in a 3 weeks duration to excavate and support the shaft. An additional 3 weeks was added to the duration for setting up to perform the shaft excavation once access has been provided.

2.6.2 Final Tunnel Lining

Two different types of final tunnel lining are included in the 60 percent design. Reinforced-concrete linings will be used in the LLOW tunnel, in the upstream 537 feet of the HLOW tunnel, and in the 160-foot-long access adit. A steel lining with a low density cellular concrete filled annulus will be used in the downstream 290 feet of the HLOW and the downstream HLOW shaft. The reinforced-concrete lining is assumed to be placed in 30-foot-long sections, with six invert sections (180 feet) placed per week and four crown and wall sections (120 feet) placed per week. The reinforced concrete lining section placement rates consider the complexity of placing the waterproofing, drainage, reinforcement, and formwork, as well as articulated joints in fault zones. Placement of the steel lining and controlled low strength material annular fill is assumed to be installed at an average rate of 200 feet per week.

2.7 SPILLWAY

Demolition of the spillway structure was assumed to be performed using excavator-mounted hoe-rams. The concrete was assumed to be broken up sufficiently on-site to enable separation of the reinforcement from the concrete rubble. The concrete rubble and reinforcing steel were assumed to

be removed from the site for recycling. Concrete demolition work was assumed to occur only during a day-shift at an average production rate of 180 cy per shift.

Placement of reinforcement and setting concrete forms would be performed during daylight hours. Concrete placements are assumed to be able to occur during day or night. Concrete placement during cool nighttime hours will likely be needed, especially when mass concrete is being placed. The duration required for construction of the gravity wall is assumed to be 40 weeks, based on an average placement of 500 cy of mass concrete per week. Invert slab placement, including keyways, is assumed to require 44 weeks, based on an average 200 cy per week. Structural concrete placement for the right approach wall and chute walls is assumed to average 100 cy per week.

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3 CONSTRUCTION SEQUENCING

Construction sequencing was developed with the primary assumption that the notice to proceed (NTP) would occur on January 8, 2024, following completion of the ADTP.

The estimated sequence of construction is summarized on Figure 3-1. The activities on the critical path and other major work activities are broken down in detail on Figure 3-2. The following sections include discussion of the details of the construction sequence.

3.1 OVERVIEW OF CRITICAL PATH

The critical path for construction of the project, once mobilization has occurred passes through the following major features of the work (red bars shown on Figure 3-2):

- Year 1 (2024): Preparation of the site.
- Year 2 (2025): Dewatering of the reservoir, Stage 1a dam excavation to an interim dam with crest El. 565, conversion of the Stage 1 diversion system into the Stage 2 diversion system.
- Year 3 (2026): Stage 1b dam excavation to an interim dam with crest El. 546 with 10 feet of freeboard (crest El. 556) provided by a sheetpile wall.
- Year 4 (2027): Stage 2a excavation of the interim dam down to the remnant core and Stage 2b fill of an interim dam with crest El. 556.
- Year 5 (2028): Stage 3a fill of an interim dam with crest El. 565.
- Year 6 (2029): Stage 3b fill to final crest El. 656 and completion of the LLOW following decommissioning of the Stage 2 diversion system.
- Year 7 (2030): Construction of Coyote Road and site restoration.

Non-critical-path activities are included in the construction sequencing shown on Figure 3-2 to indicate how they could interrelate with the critical-path activities. The sequencing of the high-level outlet works, the spillway, and the low-level outlet structure during Years 2 through Year 6 in this CSP describe a reasonable approach that could differ from that developed by the contractor. The only constraints to the sequencing of the high-level outlet works, the spillway, and the low-level outlet structure will be that the high-level outlet works has to be complete by the end of Year 5, and the spillway and LLOW including the outlet structure have to be complete by the end of Year 6.

Reservoir operations to maintain the reservoir at dead pool level El. 488 would end with dewatering the reservoir early in Year 2. Reservoir operations (initial filling of the reservoir behind the new dam) would resume at the end of Year 6 after work on the dam, the LLOW, and the spillway has been completed. The period over which the reservoir would be maintained completely empty would be about 4.5 years.

Substantial completion, being defined as when reservoir operations would be able to resume, subject to the approval of California Division of Safety of Dams, the Federal Energy and Regulatory Commission, and any other permitting requirements, would occur about 6 years following NTP. Substantial completion would include completion of the embankment, spillway, LLOW, HLOW, and installation of dam safety instrumentation (not including the automated data acquisition system).

The total construction duration is estimated to be about 7 years, not including restoration plant establishment.

3.2 DETAILED DESCRIPTION OF CONSTRUCTION SEQUENCE

The construction sequencing is described in greater detail by year in the following sections, and as shown on Figures 3-3 through 3-18.

3.2.1 Year 1

The primary activities during Year 1 are shown on Figure 3-3. One main objective needs to be completed in Year 1: preparation for initial excavation of the dam in Year 2.

Preparation for initial dam excavation includes construction of the access roads on the downstream slope of the dam and to Staging Area 1 and SA-E; and preparing Staging Area 1 and SA-E for receiving core materials (clearing of trees and demolition of infrastructure). During Year 2, approximately 115,000 bcy of core material would be placed in SA-E following moisture conditioning in Staging Area 1 and would remain until the final year (Year 6) of embankment construction. The stockpiled material would serve as mitigation against the potential risk that embankment construction is not able to be completed during Year 6 at which point the reservoir would refill to El. 528 and PGBP would no longer be accessible. The stockpiled core material coupled with shell material quarried from BHBA would then be used in Year 7 to complete the dam.

Preparation activities would also include construction of access roads to, and preparation of SA-H and SA-L for receiving shell material, SA-K for receiving core material, the RDA for receiving waste material. The access roads to SA-H, SA-L, and SA-K would be located on the reservoir rim slope at or above about El. 520 where they would be less likely⁴ to be inundated during the winter following Year 1 when storm flows would cause temporary reservoirs behind the existing dam. The access road to SA-H and SA-L would include a road across the upstream slope of the dam starting at the dam crest at the left abutment dropping to El. 530 at the right side of the dam. This access road allows construction of the cofferdam in Year 2 to not be a critical path activity. Preparation of SA-H, SA-K, and SA-L may require stripping of lake sediment depending on whether or not the reservoir level rises enough during the winter following Year 1 to inundate the stockpile areas and rehydrate the sediment.

3.2.2 Year 2

The primary activities during Year 2 are shown on Figures 3-4 through 3-6. Stage 1a excavation would start with excavated shell materials being hauled to SA-C for running over a grizzly to produce Zone 5a (transition) and SA-L for stockpiling, and the core materials being hauled to Staging Area 1/SA-E and SA-K (south) for stockpiling. As described in Section 2.5, Staging Area 1 would be used for moisture conditioning followed by moving the moisture-conditioned core to SA-E. An estimated 4,000 ecy would be placed in Staging Area 1, moisture-conditioned by discing, and then moved to SA-E every three days resulting in about 15 weeks (approximately through the end

⁴ A likelihood of the reservoir level exceeding El. 520 during the winter between Year 1 and Year 2 will be included in the next version of this CSP after SCVWD has determined how the reservoir will be operated following completion of ADTP.

of July) to stockpile the 100,000 ecy reserve. SA-K (south) has sufficient room allow moisture conditioning without the need to double handle the material in the manner required in Staging Area 1.

Reservoir dewatering through the Stage 1 diversion system should be planned to be complete as early in April as possible to take advantage of drier conditions, if present that year, to provide as long a construction season as possible for completion of the Stage 2 diversion system and Stage 1a excavation. The CSP assumes that reservoir dewatering will occur over a two-week period between April 14 and April 27 and that installation of the bypass pumping system will require an estimated 3 weeks. The bypass pumping system will pump reservoir inflows from upstream of the cofferdam to the top of the 8-foot lake tap pipe at the upstream end of the Stage 1 diversion system where inflows would then pass through the diversion system downstream to Coyote Creek.

Figure 3-4 shows the expected material flow during the first 12 weeks that would include construction of the cofferdam using materials excavated and stockpiled in SA-B during the ADTP. Construction of the cofferdam (shown on Figure 3-4) depends on the rate of flows into the reservoir following reservoir lowering. Based on 35 years of historical data, there were 3 years (equal to an approximate 10 percent likelihood) where the inflows would exceed the bypass pumping system capacity of 30 cfs requiring the start of cofferdam fill placement to be May 15 or later. For a start date of May 1, the likelihood of a delay was about 25 percent. For the purposes of developing the CSP, it was assumed that cofferdam fill placement would begin on May 19, being dependent on installation of the bypass pumping system.

As shown on Figures 3-5 and Figure 3-6, shell materials would continue to be hauled to SA-C for running over a grizzly to produce Zone 5a (transition) and SA-L for stockpiling, and core materials would continue to be hauled to Staging Area 1/SA-E and SA-K (south) for moisture-conditioning and stockpiling through near the end of the construction season.

Construction of the Stage 2 diversion system is a critical path activity as it is required in combination with the Stage 1 interim dam to provide the required level of reservoir reliability during the precipitation season between Year 2 and Year 3. The Stage 2 diversion system includes excavation of the diversion intake portal, excavation and initial support of an approximately 274-foot-long segment of the LLOW tunnel, breakthrough into the Stage 1 diversion system, construction of final lining of the 274-foot long segment of the LLOW tunnel, construction of the diversion intake structure, construction of the diversion extension pipe from the intake structure upstream to the cofferdam, and abandonment of the Stage 1 diversion system upstream of the final tunnel lining at the intersection of the Stage 1 and Stage 2 diversion systems.

As shown on Figure 3-2, construction of the components of the Stage 2 diversion system upstream of the diversion intake structure and the components downstream of, and including, the diversion intake structure would be constructed concurrently. Prior to tunneling breaking into the Stage 1 diversion system, a sandbag or other type of dam would be installed in the Stage 1 diversion tunnel just upstream of the intersection of the diversions and a pipe (size to be determined) would be used to convey flows downstream past the intersection. The intent would be to form the final lining of the low-level outlet tunnel around the pipe so that bypass flows could continue to pass into the upstream end of the Stage 1 diversion system until the Stage 2 diversion system is complete.

Following completion of the Stage 2 diversion system, the bypass pumping system would be turned off and removed and flows would be directed into the Stage 2 diversion system through the diversion extension pipe. Abandonment of the Stage 1 diversion system would include filling the pipe extending through the final lining with concrete and systematically filling approximately 50 feet of 19-foot tunnel and 334 feet of 8-foot lake tap pipe with CLSM or low-density cellular concrete.

Materials excavated during the ADTP that are remaining in SA-B after cofferdam construction and unusable materials excavated from the dam foundation would be used to construct a perimeter access road around the western portion of the RDA (see Figure 3-4). The access road would be constructed in the same manner as the cofferdam; displacement of soft lake sediment as the disposal materials are dumped at the leading edge, then pushed ahead along the access road alignment (URS, 2021b). After the access road is completed, a 5-foot thick working surface comprised of waste material, geomembrane, and geogrids (URS, 2021a) would be constructed using lighter equipment on the area of soft sediment within the perimeter road toward the reservoir bank. Waste material would be placed evenly across the working surface in 2-foot-thick lifts using the main project hauling units. By the end of Stage 1a excavation, the grade of the western portion of the RDA is estimated to be at about Elevation 475, which is 8 feet above the diversion intake structure invert elevation. The elevation for the grade of the RDA assumes an estimated settlement of 0.3 feet for every foot of material placed on the 15- to 2-foot thick layer of lake sediment at the base of the RDA.

Other activities during Year 2 that would need to be on-going but are not directly on the critical path include:

- Excavation of the downstream portal for the high-level outlet tunnel (HLOT) would start after the last of the 100,000 cy of core material has been stockpiled in SA-E and the access road from Staging Area 1 to the dam on the right abutment becomes available (Figure 3-5).
- Excavation of the downstream 500 feet of the HLOT to the gate shaft location (Figure 3-6).

As shown on Figure 3-7, the main activities that would occur through the precipitation season at the end of Year 2 and in the beginning of Year 3 would include:

- Completion of excavation and final lining of the downstream 500 feet of the HLOT to the gate shaft location.
- Demolition of the left bin wall of the existing spillway
- Excavation for the left gravity wall of the new spillway

3.2.3 Year 3

The primary activities during Year 3 are shown on Figures 3-8 and 3-9. Stage 1b excavation would continue with excavated shell materials being hauled to SA-C, SA-H, and SA-L and core materials being hauled to SA-K (south). The shell materials stockpiled in SA-C would be the volume required to construct the Stage 1b buttress on the upstream side of the Stage 1b interim dam as shown on Figure 3-9. As shown on Figure 3-9, shell materials would continue to be excavated and stockpiled through the end of the construction season at the end of October. Core materials would be

stockpiled in SA-K (south) until about the end of June. Lower fine fill material that was placed in the bottom of the shells of the existing dam would also be stockpiled separately in SA-K for reuse in the downstream shell of the dam. Prior to the beginning of the precipitation season, a sheetpile wall will be driven into the crest of the Stage 1b interim dam to raise the crest to El. 556⁵.

Unusable materials excavated from the dam foundation would be used to complete the perimeter access road around the eastern portion of the RDA (see Figure 3-8) in the same manner described for the western portion during Year 2. By the end of Stage 1b excavation (Figure 3-9), the grade of the eastern portion of the RDA is estimated to be at about Elevation 474, which is 7 feet above the diversion intake structure invert elevation.

Other activities during Year 3 that would need to be on-going but are not directly on the critical path include:

- Cochrane Road tieback wall (Figure 3-8).
- Spillway demolition (Figures 3-7 to 3-9).
- Excavation and final lining of the HLOW gate shaft (Figure 3-8).
- Excavation of the upstream portals for the Access Adit Tunnel (AAT) and the HLOT (Figure 3-8).
- Excavation and final lining of the AAT (Figure 3-8).
- Excavation and final lining of the upstream 340 feet of the HLOT to the gate shaft location (Figures 3-8 and 3-9).
- Start construction of the left gravity wall of the new spillway (Figure 3-9).

As shown on Figure 3-10, the main activities that would occur through the precipitation season at the end of Year 3 and in the beginning of Year 4 would include:

- Completion of the left gravity wall of the new spillway
- Excavation of the spillway foundation.
- Importation of filter and drain material to stockpiles in Staging Area 1 for dam construction in Year 4.

3.2.4 Year 4

The primary activities during Year 4 are shown on Figures 3-11 and 3-12. Year 4 is the most difficult with respect to excavation and embankment construction. Stage 2a excavation (Figure 3-11) needs to be successfully completed with sufficient time for foundation preparation, approval, and placement of Stage 2b fill to Elevation 556⁶ (Figure 3-12) before significant precipitation occurs at the end of the season.

⁵ The required crest elevation for the Stage 1b interim dam that will provide the desired level of public protection against overtopping.

⁶ The required crest elevation for the Stage 2b interim dam that will provide the desired level of public protection against overtopping.

Stage 2a excavation is assumed to start April 19 following removal of the Stage 1b interim dam sheetpile crest and opening of the diversion extension pipe. Shell materials would be stockpiled in SA-C and core materials would be moisture conditioned and stockpiled in SA-D (Figure 3-11). It is noted that there is a risk that a late season storm could make early use of SA-C and SA-D infeasible. Based on the historical record of flow data 1 year out of 35 years had flows in excess of the capacity of the 10-foot diversion extension pipe in the last half of April (URS, 2021c), which could temporarily raise the reservoir level above the base of SA-C and SA-D. The likelihood of reservoir level during April and May will be evaluated through the routing of the stochastic precipitation model (B&V and S&W, 2021) during the 90% design. If needed early in the Year 4 construction season, shell materials can be stockpiled in SA-L and core materials can be moisture conditioned and stockpiled in SA-K (south).

The estimated duration for Stage 2a excavation down to the remnant core is about 12 weeks, with completion on the upstream side of the remnant core in early July. Excavation on the downstream side of the remnant core is estimated to occur about 3 weeks earlier in about mid-June. As shown on Figure 3-2, the CSP assumes that approximately 1 week will be needed to complete foundation cleanup at the lowest dam foundation level. The purpose of leaving the remnant core is to reduce the area that will require extensive hand-cleaning at the bottom of the dam to the 10-foot horizontal width of the filter upstream and downstream of the core. Foundation cleaning upstream and downstream of the filters will be less extensive, being performed primarily using a smooth-bladed excavator or grade-all.

As shown on Figure 3-2, approximately 3 months to near the end of September are estimated for the Stage 2b interim dam level to reach Elevation 450; the approximate top of the remnant core (assumes average placement rates of 700 cy per day at the valley bottom rising to 6,600 cy per day as more room is available on the upstream side and 1,900 cy per day at the valley bottom rising to 3,300 cy per day on the downstream side, as shown in Appendix A). Production rates for the next 7 weeks are assumed to be about 19,000 cy per day. Production rates taper off during the final 2 weeks of Stage 2b fill placement to about 9,000 cy per day.

The production rates described above are based on working 5 days per week. Given the importance that Stage 2a excavation and Stage 2b fill be completed by the end of the dry season, it is likely that the contractor will need to use Saturdays to provide more flexibility to account for foundation cleaning issues and other issues that could reduce productivity. A more detailed analysis of the work required during Stage 2a Excavation and Stage 2b Fill below about El. 450 is included in Appendix B.

Prior to the beginning of the precipitation season, winterization measures would be installed downstream of the Stage 2b interim dam crest to protect the chimney and blanket filters and drains from contamination and erosion.

Figure 3-2 shows a portion of the downstream drain blanket work being performed concurrently with Stage 2a excavation. The concurrent drain blanket work would be in the portion of the dam foundation exposed during Stage 1b excavation, and would include construction of the clay barrier at the downstream end of the blanket.

Other activities during Year 4 that would need to be on-going, but are not directly on the critical path, include:

- Spillway construction including the invert slab and right wall (Figures 3-11 and 3-12).
- Mechanical and electrical work for the HLOW.

As shown on Figure 3-13, the main activities that would occur through the precipitation season at the end of Year 4 and in the beginning of Year 5 would include:

- Spillway construction including the right and left walls.
- Clearing of BHBA.
- Excavation of a trench to expose the downstream end of the LLOT and LLOW outlet structure foundation.
- Importation of filter and drain material to stockpiles in Staging Area 1 for dam construction in Year 5.

3.2.5 Year 5

The primary activities during Year 5 are shown on Figure 3-14.

In Year 5, the cofferdam is critical to providing access to SA-H and SA-L as the work on the sloping intake structure removes the opportunity to provide access across the upstream dam slope similar the excavation phases. The CSP assumes that the diversion extension pipe would be opened in mid-April and the last half of April being used to recondition the cofferdam and re-establish access to SA-H, SA-L, and SA-K. The only materials being placed in the dam during the first 20 weeks of embankment construction in Year 5 are shell and transition materials and imported filter and drain materials (Figure 3-14). The final 4 weeks of embankment construction in Year 5 would include all zones. All of the shell materials being placed during the first 20 weeks would be sourced from SA-H, SA-K, and SA-L. With the materials at those sources exhausted, the shell materials for the last 4 weeks would come from BHBA.

As shown on Figure 3-2, development of both the BHBA and the PGBP would start in Year 5. In BHBA, an estimated 14 weeks would be required to remove the overburden from the top of the borrow area. The excavated overburden would be used to construct the access road to the PGBP using the displacement method similar to the cofferdam (URS, 2021c). Overburden materials in excess of that required to build the PGBP access road would be placed in the RDA. Production of shell materials for placement in the dam during the later part of Year 5 would commence following removal of the overburden materials from the top of BHBA. The current CSP assumes that production of shell materials would continue until the later part of November with materials being placed in SA-B for use in Year 6. Additional analyses will be performed during the 90% design to determine how much shell material should be produced during the precipitation season between Year 5 and Year 6 in preparation for Year 6.

Following completion of the access road to the PGBP in early June, the PGBP would be prepared by stripping lake sediment and excavating investigation trenches to help plan excavation and development during Year 6. The CSP assumes that excavation, processing, and stockpiling of core

material from the PGBP would not occur in Year 5 to avoid the potential of the stockpiled material being saturated in the event of the reservoir level rising during the winter season.

Other activities during Year 5 that could start but are not directly on the critical path include:

- Completion of the new spillway (Figure 3-14).
- Construction of the LLOW outlet structure, including electrical and mechanical work (Figure 3-14).
- Construction of the cast-in-place tunnel and backfilling of trench excavation (Figure 3-14).
- Excavation of overburden from BHBA and produce Zone 4 shell material (Figure 3-14).
- Construction of access to PGBP and stripping/preparation of PGBP (Figure 3-14).
- Construction of the sloping intake structure from the middle intake to the AAT (Figure 3-14).

As shown on Figure 3-15, the main activities that would occur through the precipitation season at the end of Year 5 and in the beginning of Year 6 would include:

- Connection of the Main Avenue Pipeline to the LLOW outlet structure.
- Connection of the Anderson Force Main to the LLOW outlet structure.
- Importation of filter and drain material to stockpiles in Staging Area 1 for dam construction in Year 6.

3.2.6 Year 6

The primary activities during Year 6 are shown on Figures 3-16 through 3-18.

The CSP assumes that the diversion extension pipe would be opened in mid-April and the last half of April being used to recondition the cofferdam and re-establish access to the PGBP and SA-K. After the diversion extension pipe has been re-opened, the following activities would be performed to transition flows from the Stage 2 diversion system to the HLOW (Figure 3-16):

- Installation of a temporary bypass pumping system to pump water from upstream of the cofferdam to the HLOW intake structure.
- Transition of reservoir inflows from the Stage 2 diversion system up to the HLOW intake structure.
- Demolition of the CLSM bulkhead and temporary final lining at the intersection of the LLOT and the Diversion Tunnel.
- Construction of a temporary bulkhead at the intersection of the LLOT and the Diversion Tunnel to keep reservoir inflows passing through the HLOW and down the HLOW Drop Shaft from moving upstream in the Diversion Tunnel toward the LLOT.

During Year 6, all of the shell material will be sourced from the BHBA and all of the transition material will be sourced from SA-K(north). Importation of filter and drain materials would also occur throughout the duration of embankment construction in Year 6. The initial approximately 1½ months of Stage 3b dam construction bringing the dam to El. 570 are shown on Figure 3-16. During

this period, core material will be sourced from SA-K (south) while processing and stockpiling of core materials in the PGBP for use later in the summer occurs. The middle 2 months of Stage 3b dam construction bringing the dam to El. 610 are shown on Figure 3-17. During this period, core materials would be sourced from a combination of SA-K (south), the PGBP, and SA-E. The final 2½ months of Stage 3b dam construction are shown on Figure 3-18. During this period core materials would be sourced from the PGBP and SA-E. A careful assessment of the volume of material remaining in SA-E would need to be made prior to October; and if needed, additional core materials could be sourced from PGBP before the cofferdam is abandoned, cutting off access to PGBP.

The other activity that is on the critical path during Year 6 is completion of the LLOW. This activity is considered in the CSP as two activities; the work required upstream of the upstream of the LLOT, and the work required within the LLOT to the LLOW outlet structure. Work required upstream of the LLOT following transiting of reservoir inflows from the Stage 2 diversion system to the HLOW includes the following:

- Excavation for bottom thrust block and sloping intake structure from the bottom of the structure to the middle intake (Figure 3-16).
- Installation of 78-inch and 33-inch pipe bends at bottom of intake structure (Figure 3-16).
- Construct thrust block (Figure 3-16).
- Construct sloping intake structure from the bottom of the structure to the middle intake (Figures 3-16 and 3-17).
- Install mechanical and electrical (Figure 3-17).

Work required within the LLOT to the LLOW outlet structure includes the following:

- Demolition of the diversion intake structure (Figure 3-16).
- Construction of the final lining for the LLOT at the intersection of the LLOT and the Diversion Tunnel (Figure 3-16).
- Installation of 78-inch and 33-inch pipes in 12-foot portion of LLOT (Figure 3-16).
- Construction of pipe supports in LLOT (Figures 3-16 and 3-17).
- Installation of 78-inch pipe in LLOT (Figure 3-17).
- Installation of 33-inch pipe in LLOT (Figure 3-18).
- Installation of mechanical and electrical (Figure 3-18).

Testing of the installed mechanical systems would follow completion of the LLOW near the end of the Year 6 construction season.

Based on the CSP, Substantial Completion (being defined as completion of the dam, spillway, HLOW, and LLOW) is estimated to be on October 30, 2029.

Other activities during Year 6 that need to be completed or can be started but are not directly on the critical path include:

- Placement of the fillet fill on the right upstream slope of the dam (Figure 3-17). The fillet fill backfills a portion of the upstream slope at the right side that was over-steepened to provide room for completion of the LLOW following decommissioning of the Stage 2 diversion system. This activity needs to be complete at the end of the Year 6 construction season.
- Construction of the permanent parking area at the downstream toe of the dam, and its associated entrance onto Cochrane Road. (this activity could be done in Year 5)
- Restore BHBA.
- Start restoration of upper parking area.

3.2.7 Year 7

Final completion of the project would occur in Year 7. Work items that would be completed during Year 7 would include installation of automated data acquisition systems, security systems, completion of permanent roads, restoration of the site, and demobilization. Currently, the extent of work required for restoration is not known. The CSP reserves the entirety of the construction season during Year 7 for restoration activities, as shown on Figure 3-2.

4 AREAS OF RISK AND RECOMMENDATIONS

Potential risks that could occur during the ADSRP have been developed during risk workshops documented in a risk register (B&V, 2020a) and risk management status memorandum (B&V, 2020b) and are not discussed in detail in this CSP. However, this updated CSP highlights three of the construction seasons that carry substantial risk, which are Year 2, Year 4, and Year 6 as described below. Opportunities for risk reduction are also pointed out below and in Section 4.4.

4.1 YEAR 2

The most consequential dam safety risk during the Year 2 construction season is completion of conversion of the Stage 1 diversion system to the Stage 2 diversion system by the end of the Year 2 construction season. If for some reason, the Stage 2 diversion system is not complete prior to the onset of substantial precipitation, reservoir reliability against overtopping of the Stage 1a interim dam during the precipitation season would be reduced. If not completed, work on the Stage 2 diversion system would continue into the precipitation season as long as practicable. A risk reduction measure that could be implemented, if needed, would be to include in the plans a sloped emergency trash rack design that could be installed at the upstream end of the 12-foot steel pipe that would be designed to catch large debris but allow the diversion system to operate.

4.2 YEAR 4

The most consequential dam safety risk during the Year 4 construction season is completion of the Stage 2b interim dam by the end of the Year 4 construction season. If for some reason, the Stage 2b interim dam is not complete to dam crest El. 556 prior to the onset of substantial precipitation, reservoir reliability during the precipitation season would be significantly reduced. Risk reduction measures include working into the precipitation season, albeit with much less efficiency, as long as it takes to complete the Stage 2b interim dam and installation of sheetpile freeboard (similar to the Stage 1b interim dam) to attain as much crest height as possible. Installation of sheetpile freeboard would require excavation and replacement of the core to the sheetpile depth following removal of the sheetpile. A very wet spring at the start of Year 4, if it would delay starting Stage 2a excavation, would increase the likelihood of not being able to complete the Stage 2b interim dam. In preparation of the ADSRP bid documents, consideration should be made to include a bid item for the cost to delay the start of Stage 2a excavation to the next year.

4.3 YEAR 6

The most consequential risk during the Year 6 construction season is completion of the sloping intake structure by the end of the Year 6 construction season. During the precipitation season following Year 6, because the Stage 2 diversion system will have been decommissioned, the reservoir level could rise up to the HLOW intake structure (El. 528) or temporarily higher depending on reservoir inflows. Flooding of the intake structure would occur if portions of the work that would directly expose the interior sloping intake structure are not complete prior to the onset of substantial precipitation. Divers could potentially be used to complete the in-reservoir work, depending on the work to be completed. If the remaining work were to require lowering of the reservoir in Year 7 the only option for lowering the reservoir would be by pumping to the HLOW. In the event the unfinished work was on the interior of the sloping intake structure, such work would be able to continue as the reservoir fills to the HLOW intake structure. Note that this

risk would not represent a dam safety risk since the HLOW would be able to operate as the diversion system during Year 7 while the LLOW is completed.

4.4 RECOMMENDATIONS

The following recommendations are made on the basis of this construction sequencing plan:

1. The District schedule another Risk Workshop to review the previously developed risks to update the risks that have already been defined with respect to the updated CSP and identify any new risks that might arise from the updated CSP.
2. The schedule presented in Section 3 has been developed with some schedule contingency where possible. However, the schedule to complete construction of the Stage 2 diversion system in Year 2, the Stage 2b Fill in Year 4, and the in-reservoir portion of the LLOW in Year 6 is challenging. It is recommended that the District continue to develop additional strategies moving forward to mitigate the risks to the extent possible.
3. Successful construction of ADSRP will require a contractor that proactively manages the work to try and stay ahead of a variety of conditions that could occur during project implementation. To have the best possible chance of meeting the schedule, URS recommends that the District procure the project using a Best Value approach, rather than a Low Bid approach. The Best Value approach was first raised at the Value Engineering Workshop held from October 2-4, 2017, and has been discussed at a number of Board of Consultant meetings since then. The Best Value procurement approach would allow the District to select the contractor on the basis of qualifications, approach to construction, and cost. Although the initial cost for the selected contractor could be greater than the lowest bid, the actual costs for the project would likely be less due to reduced claims, given the qualifications, planning, and innovation brought to the project by the selected contractor.

5 LIMITATIONS

URS represents that its services were conducted in a manner consistent with the standard of care ordinarily applied as the state of practice in the profession, within the limits prescribed by our client. No other warranties, either expressed or implied, are included or intended in this technical memorandum.

This technical memorandum is intended for the sole use of Santa Clara Valley Water District. The scope of services performed during this study may not be appropriate to satisfy the needs of other users, and any use or reuse of this document, or of the findings, conclusions, or recommendations presented herein, is at the sole risk of said user.

Background information, design bases, and other data have been furnished to URS by Santa Clara Valley Water District and/or third parties, and URS has used this information, design bases, and other data in preparing this technical memorandum. URS has relied on this information as furnished, and is neither responsible for nor has confirmed the accuracy of this information.

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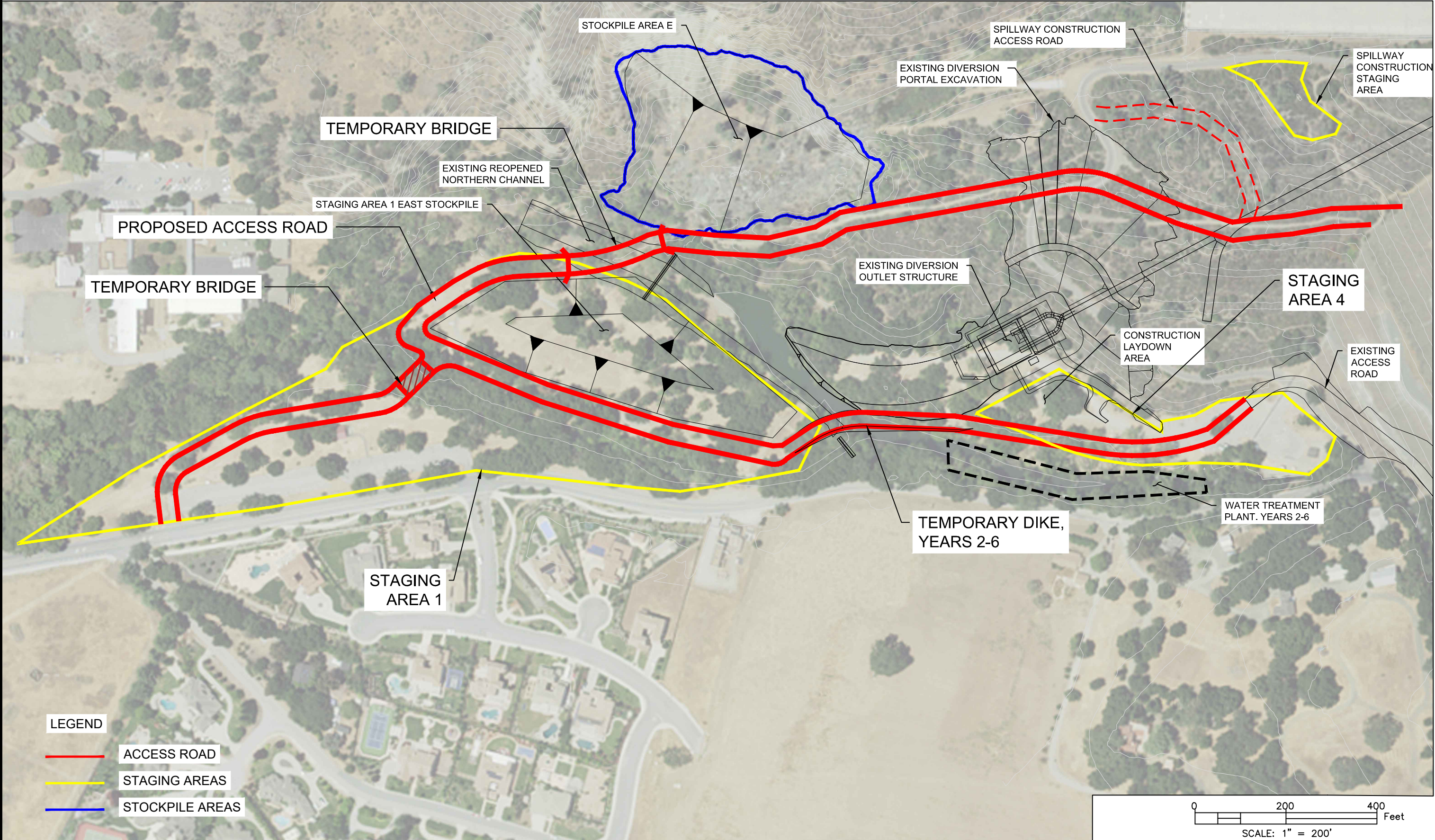
6 REFERENCES

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Figures

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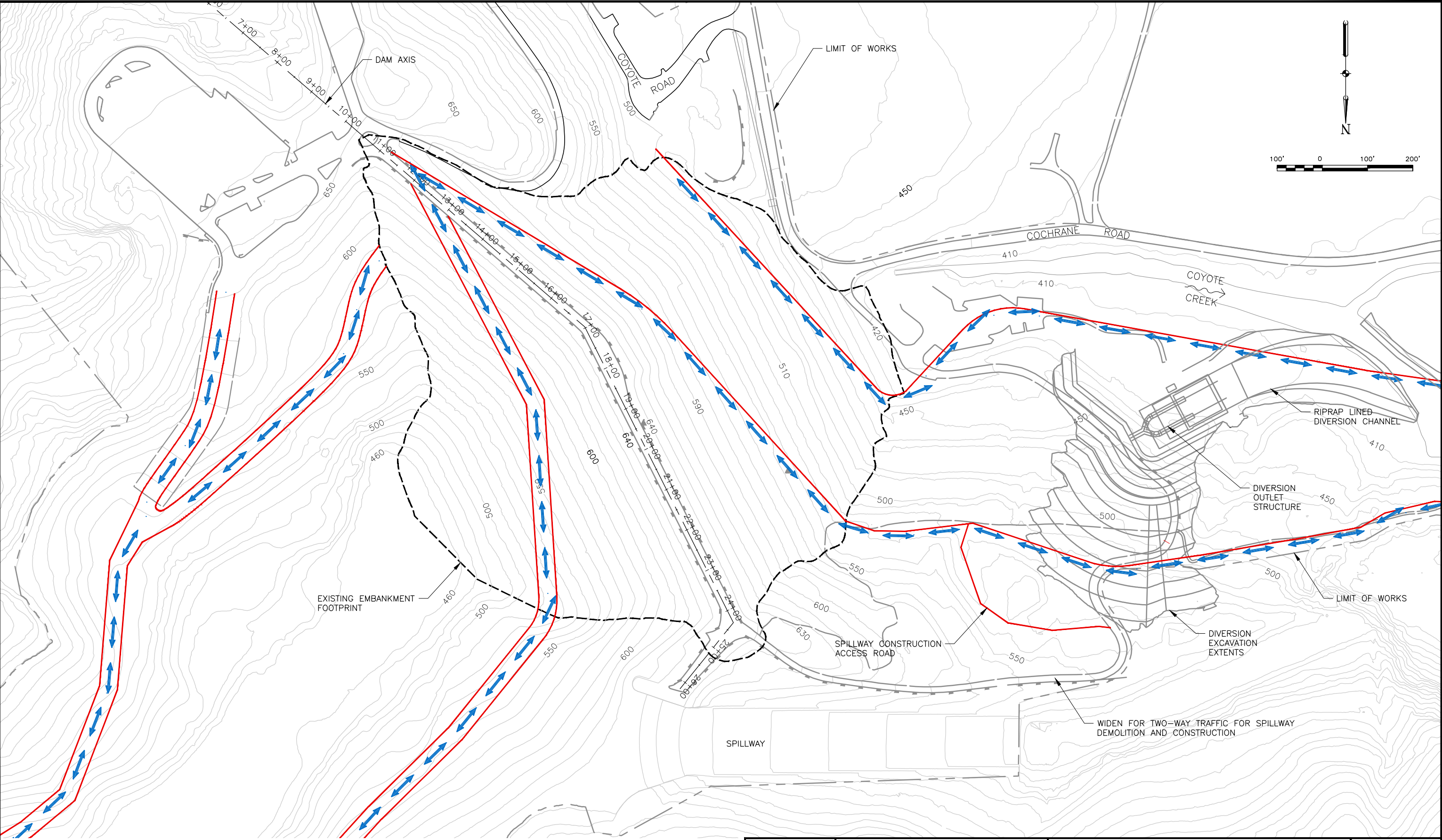
PROJECT NO. 26818793

SCVWD
Anderson Dam
Seismic Retrofit Project

PROPOSED ACCESS ROADS
DOWNSTREAM SIDE OF DAM

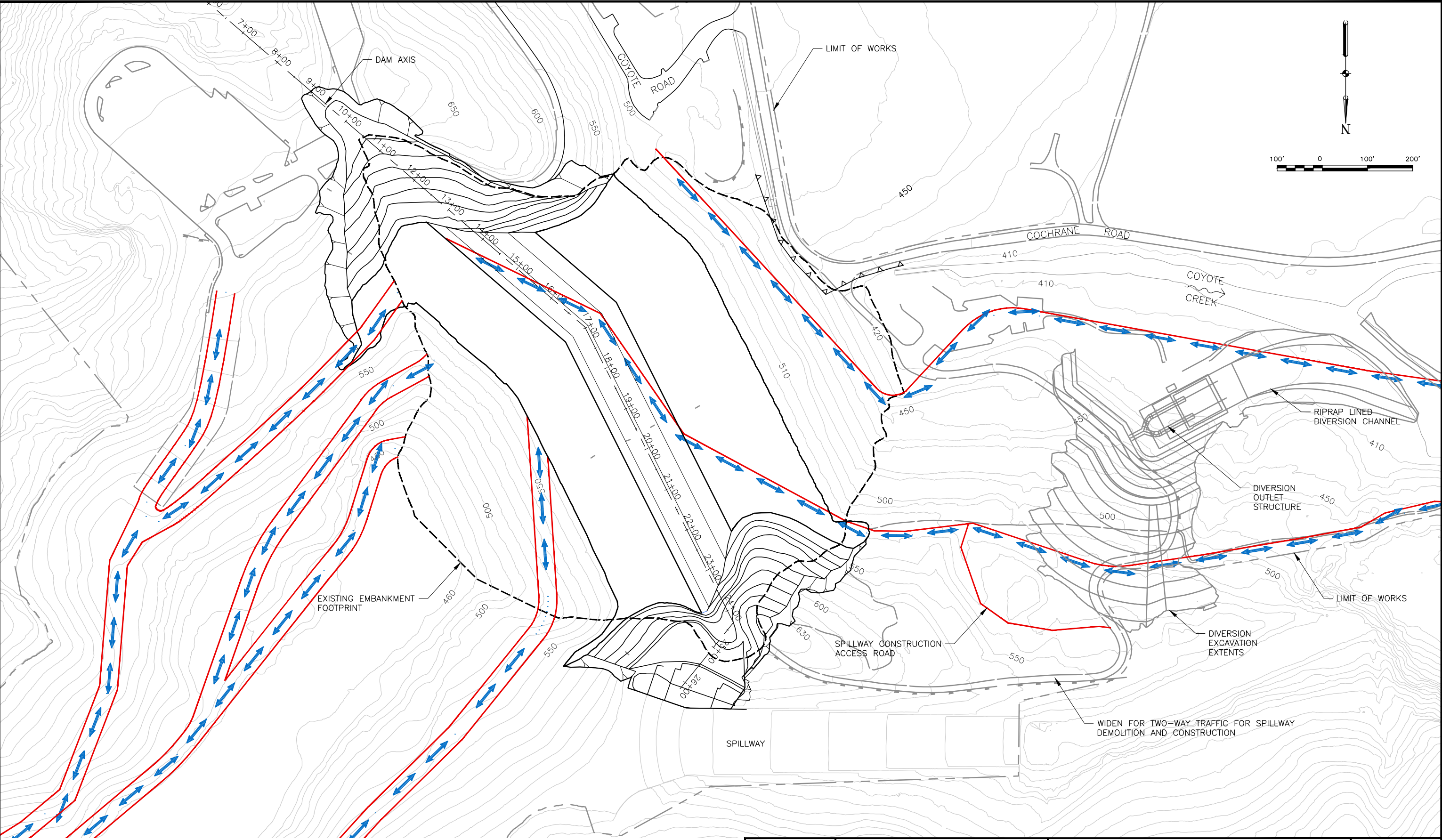
Figure
2-2

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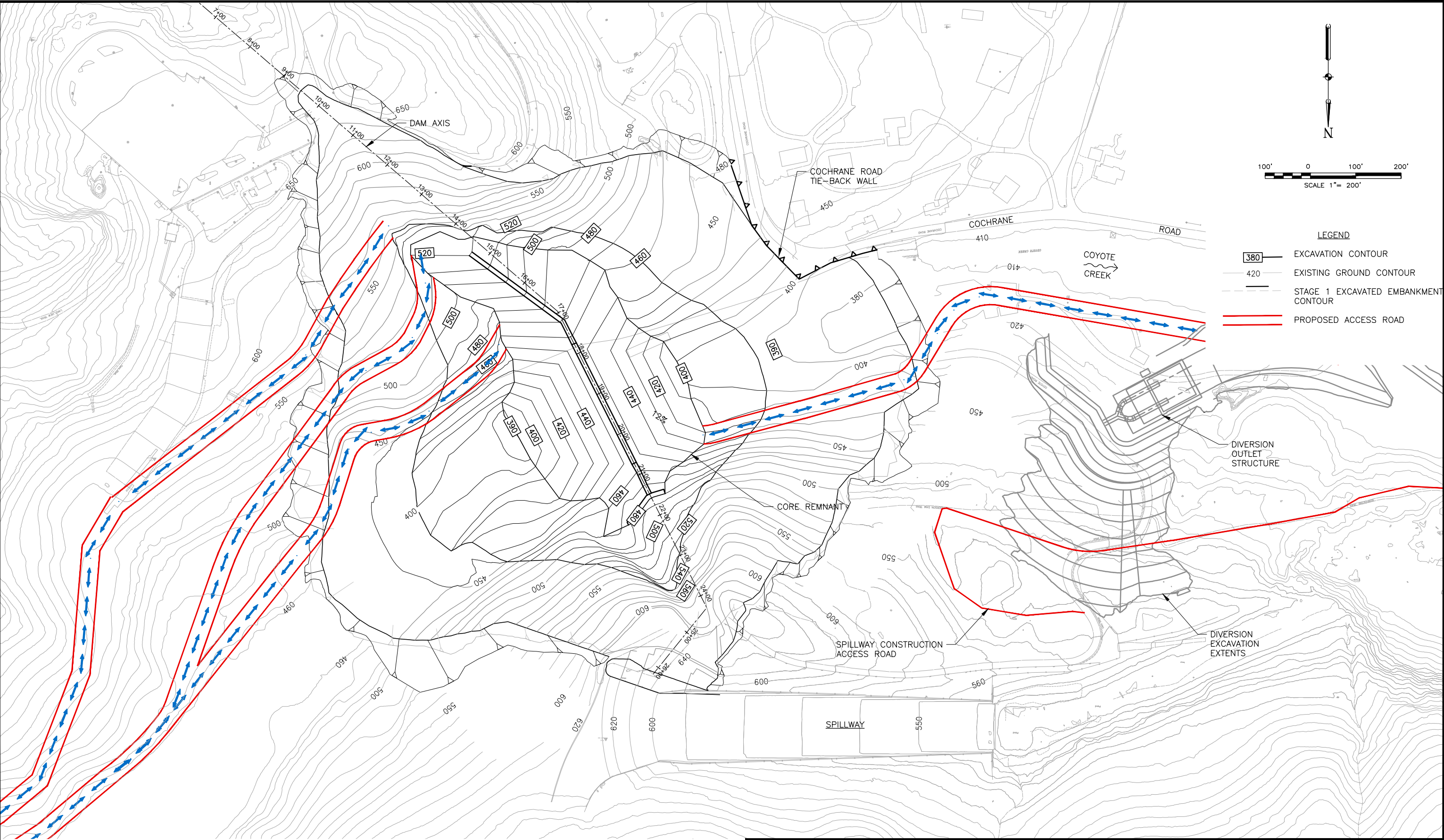
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	SCVWD Anderson Dam Seismic Retrofit Project		

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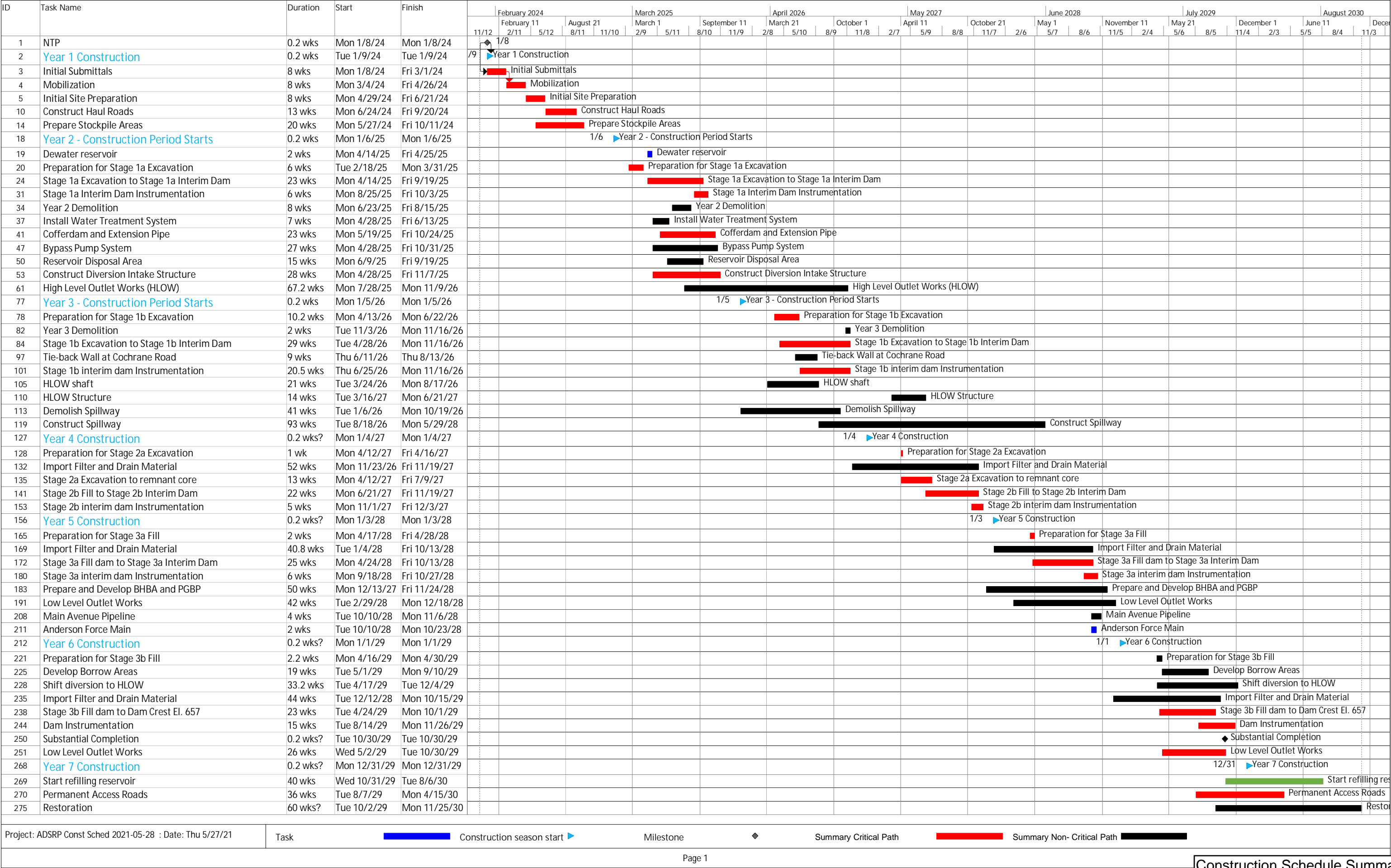


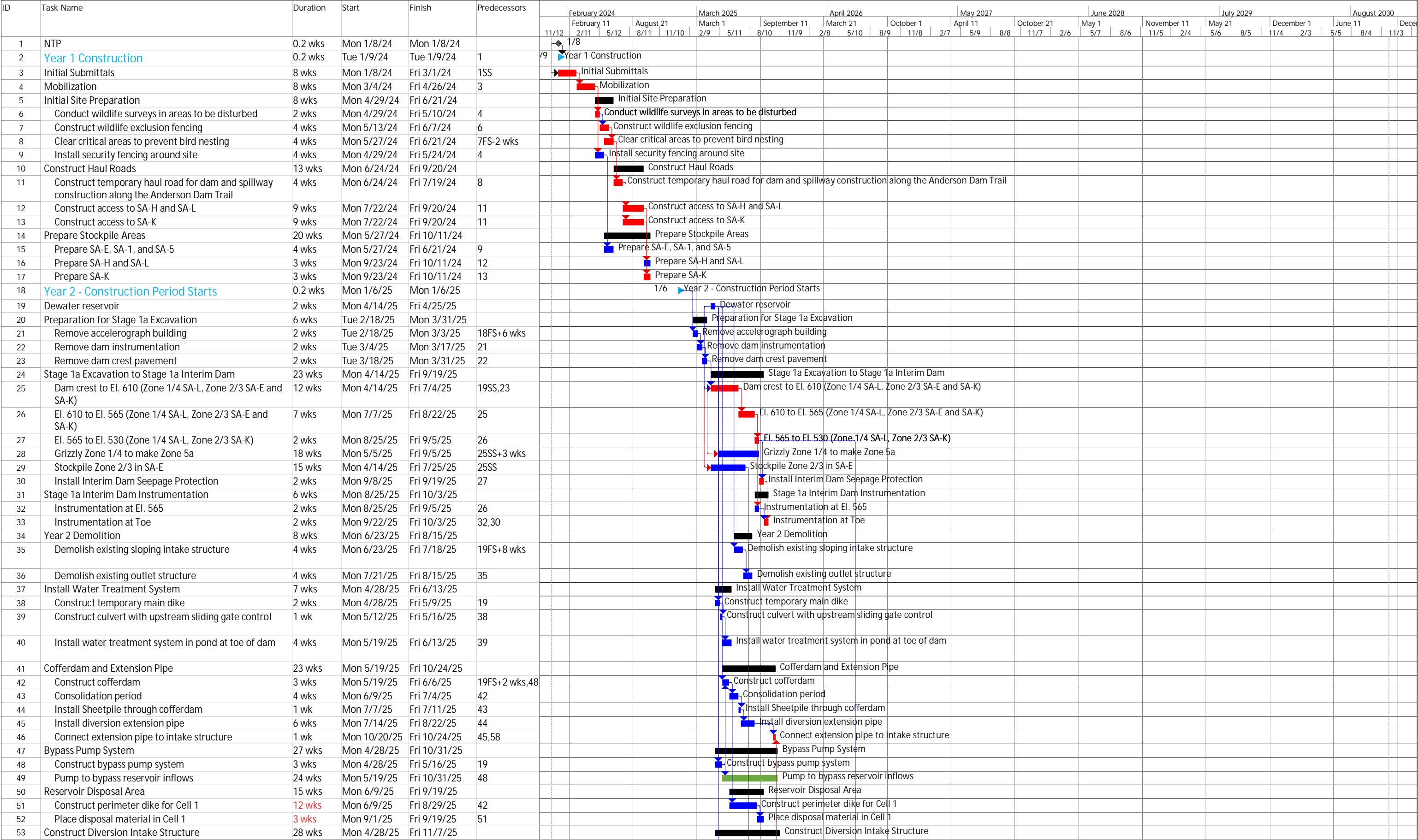
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URS	Project No. 26818793	ACCESS ROADS FOR STAGE 2B FILL	Figure 2-6
	SCVWD Anderson Dam Seismic Retrofit Project		





ID	Task Name	Duration	Start	Finish	Predecessors	Calendar																																		
						February 2024					March 2025					April 2026					May 2027					June 2028					July 2029					August 2030				
						11/12	2/11	5/12	8/11	11/10	2/9	5/11	8/10	11/9	2/8	5/10	8/9	11/8	2/7	5/9	8/8	11/7	2/6	5/7	8/6	11/5	2/4	5/6	8/5	11/4	2/3	5/5	8/4	11/3						
105	HLOW shaft	21 wks	Tue 3/24/26	Mon 8/17/26																																				
106	Excavate gravity wall foundation	2 wks	Tue 3/24/26	Mon 4/6/26	114																																			
107	Excavate and support HLOW gate shaft	6 wks	Tue 4/7/26	Mon 5/18/26	106,67																																			
108	Reinforced concrete liner HLOW gate shaft to access adit invert	3 wks	Tue 6/16/26	Mon 7/6/26	107,63																																			
109	Reinforced concrete liner access adit invert to top of shaft	6 wks	Tue 7/7/26	Mon 8/17/26	108																																			
110	HLOW Structure	14 wks	Tue 3/16/27	Mon 6/21/27																																				
111	Install mechanical	8 wks	Tue 3/16/27	Mon 5/10/27	123																																			
112	Install electrical	6 wks	Tue 5/11/27	Mon 6/21/27	111																																			
113	Demolish Spillway	41 wks	Tue 1/6/26	Mon 10/19/26																																				
114	Demolish left bin wall	11 wks	Tue 1/6/26	Mon 3/23/26	77																																			
115	Demolish left chute wall	3 wks	Tue 3/24/26	Mon 4/13/26	114																																			
116	Demolish right bin wall	11 wks	Tue 4/14/26	Mon 6/29/26	115																																			
117	Demolish right chute wall	3 wks	Tue 6/30/26	Mon 7/20/26	116																																			
118	Demolish invert slab	13 wks	Tue 7/21/26	Mon 10/19/26	117																																			
119	Construct Spillway	93 wks	Tue 8/18/26	Mon 5/29/28																																				
120	Excavate for invert slab and left chute wall	10 wks	Tue 10/20/26	Mon 12/28/26	118																																			
121	Clean invert foundation	52 wks	Tue 12/29/26	Mon 12/27/27	120																																			
122	Invert slab	44 wks	Tue 4/6/27	Mon 2/7/28	121SS+14 wks																																			
123	Gravity wall	30 wks	Tue 8/18/26	Mon 3/15/27	114,109																																			
124	Right approach wall	19 wks	Tue 3/16/27	Mon 7/26/27	123																																			
125	Right chute wall	22 wks	Tue 9/7/27	Mon 2/7/28	122FF,124																																			
126	Left chute wall	16 wks	Tue 2/8/28	Mon 5/29/28	125																																			
127	Year 4 Construction	0.2 wks?	Mon 1/4/27	Mon 1/4/27																																				
128	Preparation for Stage 2a Excavation	1 wk	Mon 4/12/27	Fri 4/16/27																																				
129	Remove Diversion Extension Bulkhead	0.2 wks	Mon 4/12/27	Mon 4/12/27																																				
130	Demolish Stage 1b Instrumentation	1 wk	Mon 4/12/27	Fri 4/16/27	129SS																																			
131	Remove sheetpile	1 wk	Mon 4/12/27	Fri 4/16/27	129SS																																			
132	Import Filter and Drain Material	52 wks	Mon 11/23/26	Fri 11/19/27																																				
133	Import filter and drain to SA-1N	22 wks	Mon 11/23/26	Fri 4/23/27	140SS-20 wks																																			
134	Import filter and drain direct to dam	30 wks	Mon 4/26/27	Fri 11/19/27	133																																			
135	Stage 2a Excavation to remnant core	13 wks	Mon 4/12/27	Fri 7/9/27																																				
136	El. 546 to El. 450 (Z1/4 to SA-C, Z2/3 to SA-D)	7 wks	Mon 4/19/27	Fri 6/4/27	131																																			
137	El. 450 to Fnd (US - Z1/4 to SA-C, SA-K, Z2/3 to SA-D, SA-K)	5 wks	Mon 6/7/27	Fri 7/9/27	136																																			
138	El. 450 to Fnd (DS - Z4 to SA-C, SA-K, Z2/3 to SA-D, SA-K)Down	2 wks	Mon 6/7/27	Fri 6/18/27	136																																			
139	Treat Rock Drain in Zone 2/3	1 wk	Mon 6/21/27	Fri 6/25/27	138																																			
140	Drain blanket d/s of Stage 2b	10 wks	Mon 4/12/27	Fri 6/18/27	129SS																																			
141	Stage 2b Fill to Stage 2b Interim Dam	22 wks	Mon 6/21/27	Fri 11/19/27																																				
142	Upstream up to El. 450 ft	11 wks	Mon 7/12/27	Fri 9/24/27																																				
143	Clean Stage 2b shell foundation	1 wk	Mon 7/12/27	Fri 7/16/27	137																																			
144	Foundation to El. 410	4 wks	Mon 7/19/27	Fri 8/13/27	143																																			
145	El. 410 to El. 450	6 wks	Mon 8/16/27	Fri 9/24/27	144																																			
146	Downstream up to El. 450	13 wks	Mon 6/21/27	Fri 9/17/27																																				
147	Clean Stage 2b shell foundation	1 wk	Mon 6/21/27	Fri 6/25/27	138																																			
148	Foundation to El. 416	7 wks	Mon 6/28/27	Fri 8/13/27	147																																			
149	El. 416 to El. 450	5 wks	Mon 8/16/27	Fri 9/17/27	148																																			
150	Prepare core foundation	8 wks	Mon 9/27/27	Fri 11/19/27	151SS																																			
151	Place embankment to El. 510	5 wks	Mon 9/27/27	Fri 10/29/27	145,149																																			
152	Place embankment to El. 556	3 wks	Mon 11/1/27	Fri 11/19/27	151																																			
153	Stage 2b interim dam Instrumentation	5 wks	Mon 11/1/27	Fri 12/3/27																																				
154	Instrumentation at El 500 ft	2 wks	Mon 11/1/27	Fri 11/12/27	151																																			
155	Instrumentation at Crest	2 wks	Mon 11/22/27	Fri 12/3/27	152																																			
156	Year 5 Construction	0.2 wks?	Mon 1/3/28	Mon 1/3/28																																				
165	Preparation for Stage 3a Fill	2 wks	Mon 4/17/28	Fri 4/28/28																																				
166	Remove Diversion Extension Bulkhead	0.2 wks	Mon 4/17/28	Mon 4/17/28																																				

Project: ADSRP Const Sched 2021-05-28 : Date: Thu 5/27/21

Task

Construction season start ▶

Milestone ◆

Critical Path

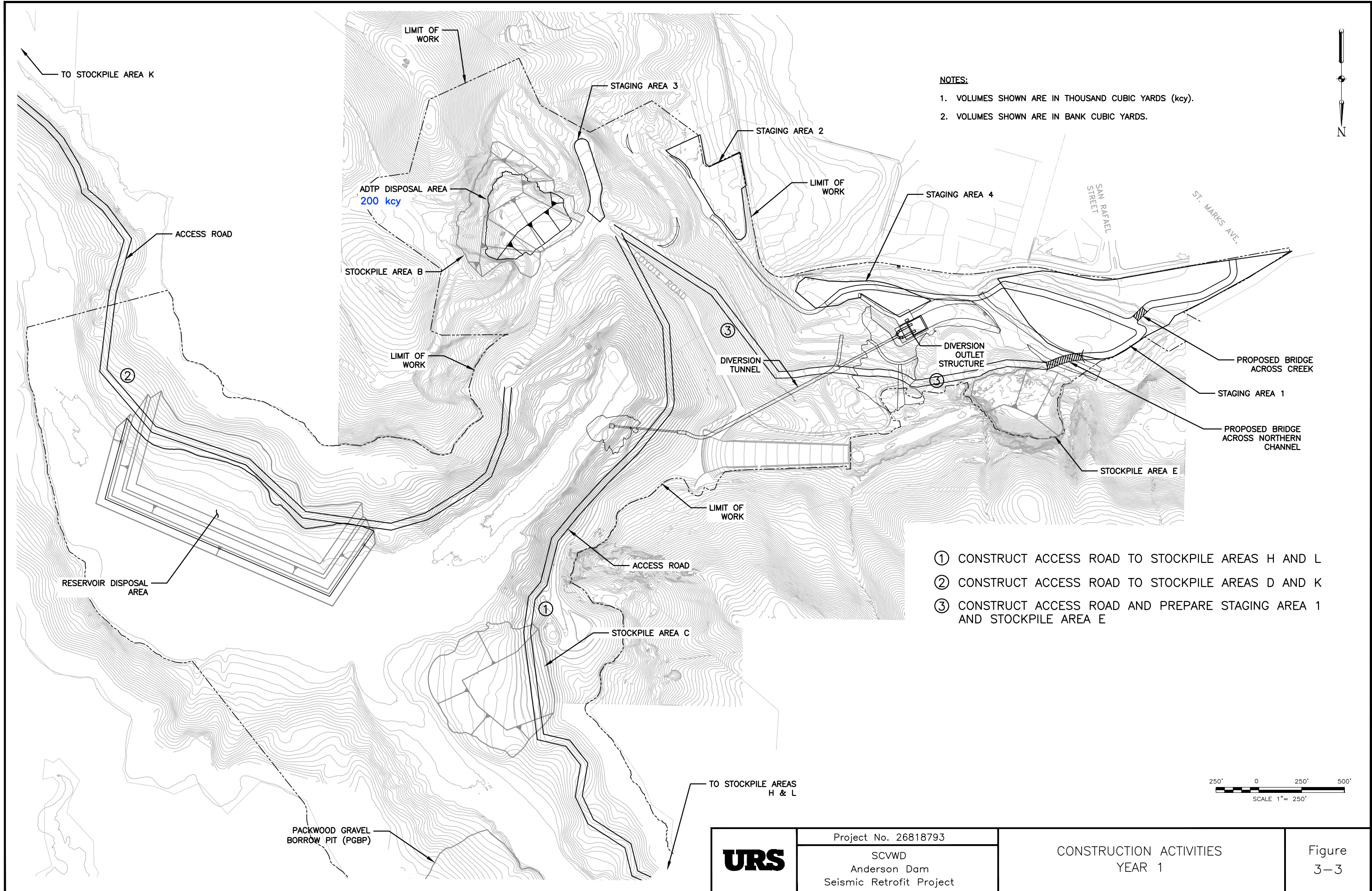
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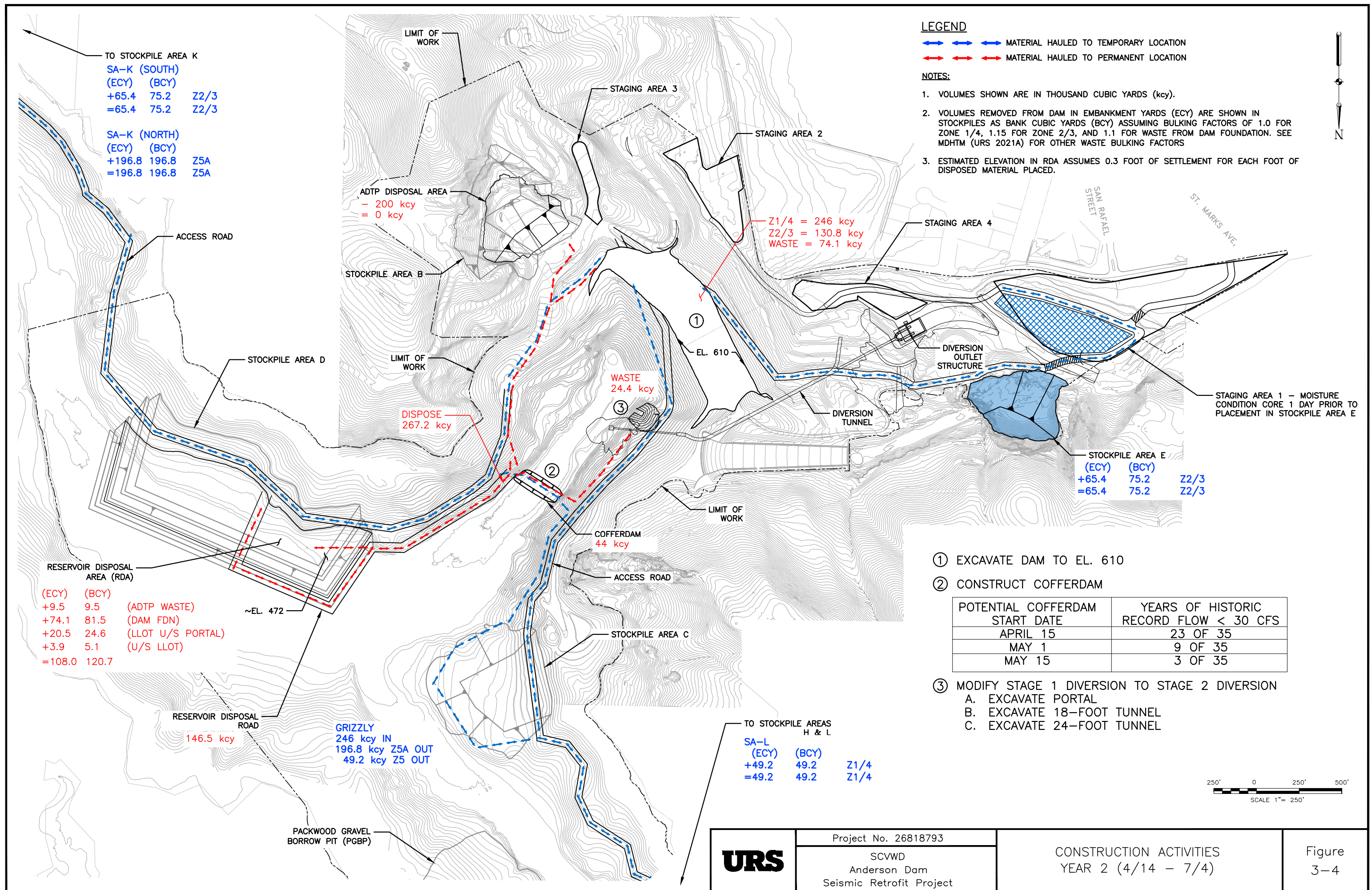
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Construction Schedule

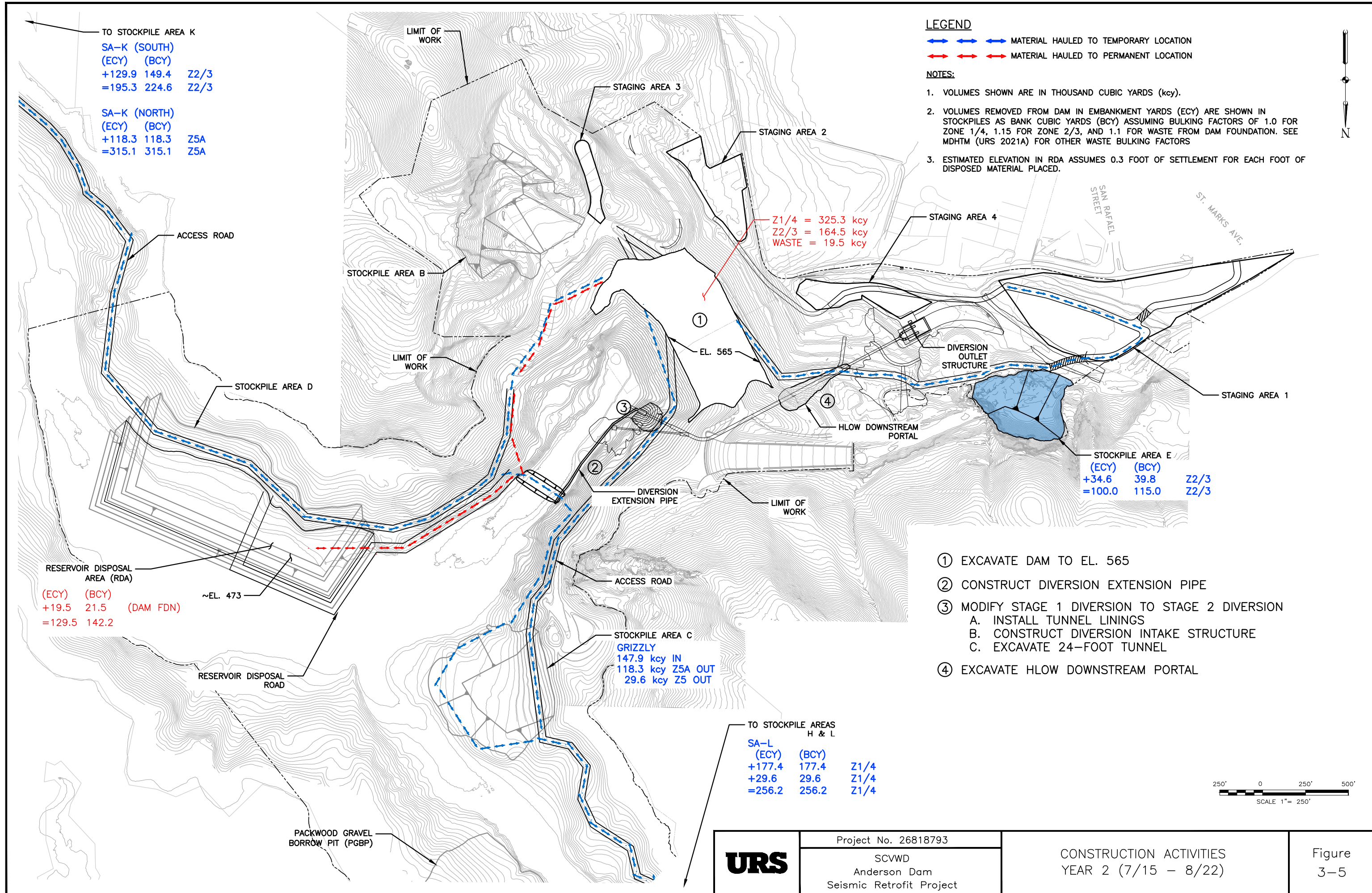
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						11/12	2/11	5/12	8/11	11/10	2/9	5/11	8/10	11/9	2/8	5/10	8/9	11/8	2/7	5/9	8/8	11/7	2/6	5/7	8/6	11/5	2/4	5/6	8/5	11/4	2/3	5/5	8/4	11/3	
167	Recondition cofferdam	2 wks	Mon 4/17/28	Fri 4/28/28	166SS																														
168	Demolish Stage 2b Instrumentation	1 wk	Mon 4/17/28	Fri 4/21/28	166SS																														
169	Import Filter and Drain Material	40.8 wks	Tue 1/4/28	Fri 10/13/28																															
170	Import filter and drain to SA-1N	7 wks	Tue 1/4/28	Mon 2/21/28	156																														
171	Import filter and drain direct to dam	24 wks	Mon 5/1/28	Fri 10/13/28	174SS,170																														
172	Stage 3a Fill dam to Stage 3a Interim Dam	25 wks	Mon 4/24/28	Fri 10/13/28																															
173	Downstream up to El. 555 ft.	24 wks	Mon 5/1/28	Fri 10/13/28																															
174	Place embankment to El. 530	20 wks	Mon 5/1/28	Fri 9/15/28	168,167																														
175	Prepare core foundation	4 wks	Mon 9/18/28	Fri 10/13/28	174																														
176	Place embankment to El 556 ft	4 wks	Mon 9/18/28	Fri 10/13/28	174																														
177	Upstream up to El. 565'	20 wks	Mon 4/24/28	Fri 9/8/28																															
178	El. 450 to El. 530 ft	12 wks	Mon 4/24/28	Fri 7/14/28	168																														
179	El. 530 to El. 565 ft	8 wks	Mon 7/17/28	Fri 9/8/28	178																														
180	Stage 3a interim dam Instrumentation	6 wks	Mon 9/18/28	Fri 10/27/28																															
181	Instrumentation at El 496 ft	2 wks	Mon 9/18/28	Fri 9/29/28	174																														
182	Instrumentation at El. 565 ft	2 wks	Mon 10/16/28	Fri 10/27/28	179,176																														
183	Prepare and Develop BHBA and PGBP	50 wks	Mon 12/13/27	Fri 11/24/28																															
184	Clear and Grub in BHBA	3 wks	Mon 12/13/27	Mon 1/3/28	156SF																														
185	Strip topsoil in BHBA	1 wk	Mon 4/10/28	Mon 4/17/28	184,167SF																														
186	Excavate and haul BHBA overburden to PGBP road	8 wks	Mon 4/17/28	Fri 6/9/28	185																														
187	Excavate and haul BHBA overburden to Reservoir Disposal Area	14 wks	Mon 4/17/28	Fri 7/21/28	185																														
188	BHBA Excavate, process, and stockpile	18 wks	Mon 7/24/28	Fri 11/24/28	187																														
189	Strip sediment in PGBP	3 wks	Mon 6/12/28	Fri 6/30/28	186																														
190	Excavate test trenches in PGBP	3 wks	Mon 7/3/28	Fri 7/21/28	189																														
191	Low Level Outlet Works	42 wks	Tue 2/29/28	Mon 12/18/28																															
192	Construct CIP tunnel Sta 15+50 to OCS	26 wks	Tue 2/29/28	Mon 8/28/28																															
193	Excavate trench to expose LLOW tunnel at 15+50	9 wks	Tue 2/29/28	Mon 5/1/28	156FS+8 wks																														
194	Remove bulkhead at LLOT STA 15+50	1 wk	Tue 5/2/28	Mon 5/8/28	193																														
195	Construct reinforced CIP tunnel	13 wks	Tue 5/9/28	Mon 8/7/28	194																														
196	Backfill trench excavation	3 wks	Tue 8/8/28	Mon 8/28/28	195																														
197	LLOW Outlet Structure	33 wks	Tue 5/2/28	Mon 12/18/28																															
198	Excavate outlet structure foundation	3 wks	Tue 5/2/28	Mon 5/22/28	193																														
199	Place concrete thrust block and concrete foundation	4 wks	Tue 5/23/28	Mon 6/19/28	198																														
200	Construct structure	16 wks	Tue 6/20/28	Mon 10/9/28	199																														
201	Install Mechanical	6 wks	Tue 10/10/28	Mon 11/20/28	200																														
202	Install Electrical	4 wks	Tue 11/21/28	Mon 12/18/28	201																														
203	Sloping Intake (Middle Intake to AAT)	24 wks	Mon 5/1/28	Fri 10/13/28																															
204	Construct Access	2 wks	Mon 5/1/28	Fri 5/12/28	167																														
205	Excavate Foundation	4 wks	Mon 5/15/28	Fri 6/9/28	204																														
206	Construct Concrete Structure	16 wks	Mon 6/12/28	Fri 9/29/28	205																														
207	Install Bulkhead at Middle Intake	2 wks	Mon 10/2/28	Fri 10/13/28	206																														
208	Main Avenue Pipeline	4 wks	Tue 10/10/28	Mon 11/6/28																															
209	Cochrane Road to tieback wall	2 wks	Tue 10/10/28	Mon 10/23/28	200																														
210	Tieback wall to outlet structure	2 wks	Tue 10/24/28	Mon 11/6/28	209																														
211	Anderson Force Main	2 wks	Tue 10/10/28	Mon 10/23/28	200																														
212	Year 6 Construction	0.2 wks?	Mon 1/1/29	Mon 1/1/29																															
221	Preparation for Stage 3b Fill	2.2 wks	Mon 4/16/29	Mon 4/30/29																															
222	Remove Diversion Extension Bulkhead	0.2 wks	Mon 4/16/29	Mon 4/16/29																															
223	Re-establish access to PGBP and SA-K	2 wks	Tue 4/17/29	Mon 4/30/29	222																														
224	Demolish Stage 3a Instrumentation	1 wk	Tue 4/17/29	Mon 4/23/29	222																														
225	Develop Borrow Areas	19 wks	Tue 5/1/29	Mon 9/10/29																															
226	Excavate, process, stockpile shell in BHBA/SA-B	19 wks	Tue 5/1/29	Mon 9/10/29	240SS																														
227	Excavate, process, and stockpile core in PGBP	19 wks	Tue 5/1/29	Mon 9/10/29	223																														
228	Shift diversion to HLOW	33.2 wks	Tue 4/17/29	Tue 12/4/29																															
229	Install bypass system from cofferdam to HLOW intake structure	2 wks	Tue 4/17/29	Mon 4/30/29	222																														
Project: ADSRP Const Sched 2021-05-28 : Date: Thu 5/27/21		Task <div><div></div></div> Construction season start <div><div></div></div> Milestone <div><div></div></div> Critical Path <div><div></div></div> Summary <div><div></div></div>																																	
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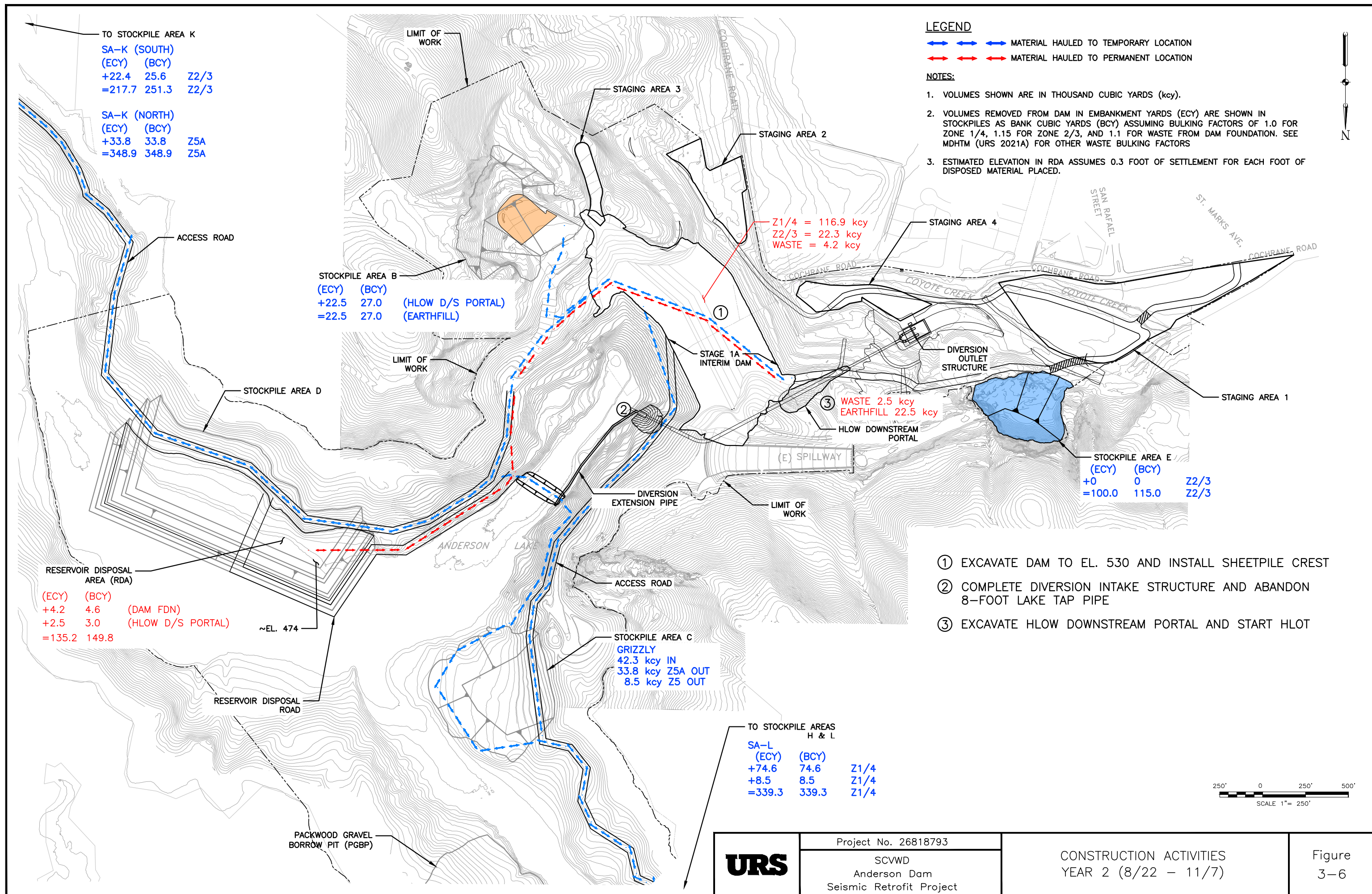
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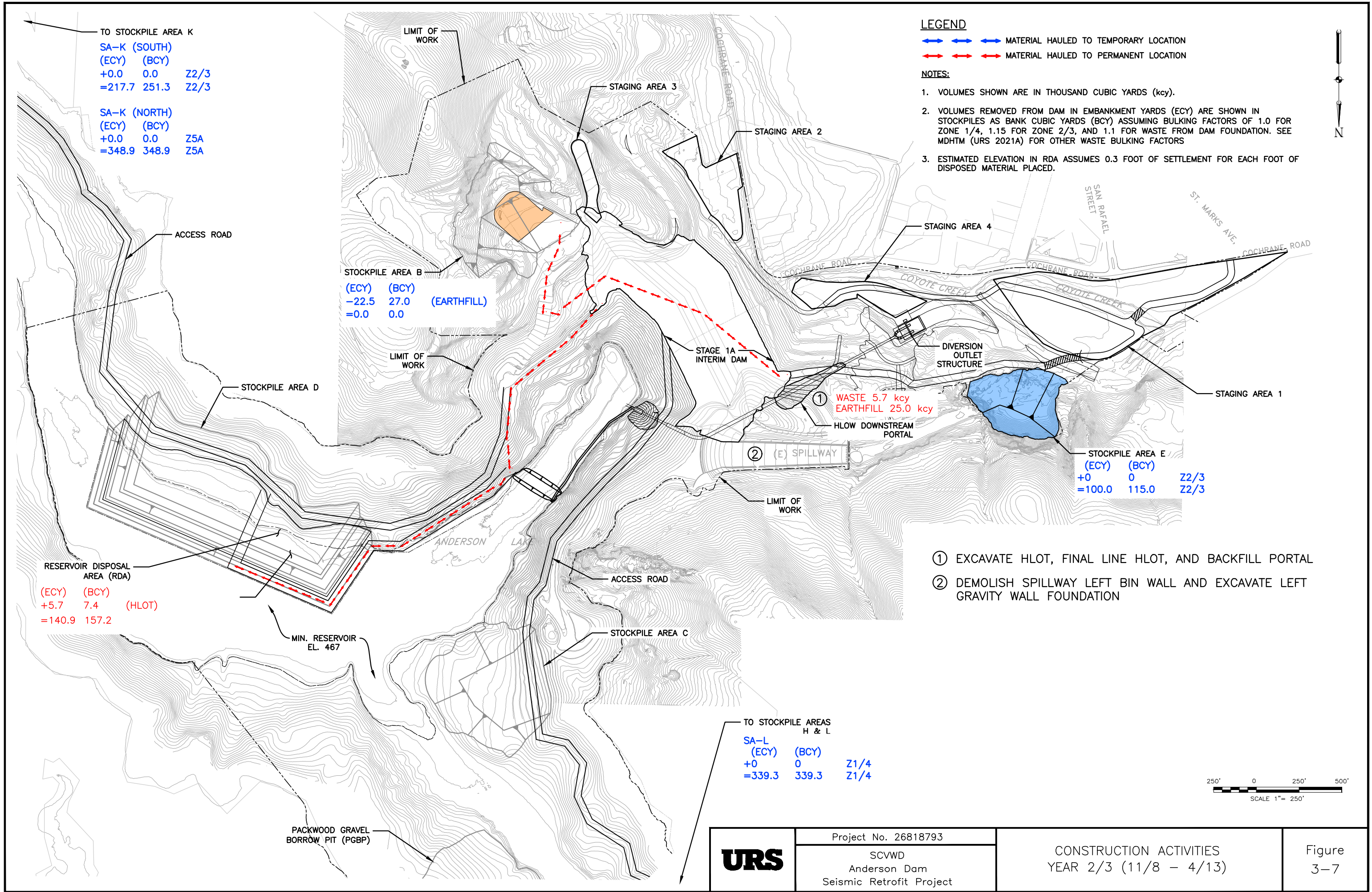


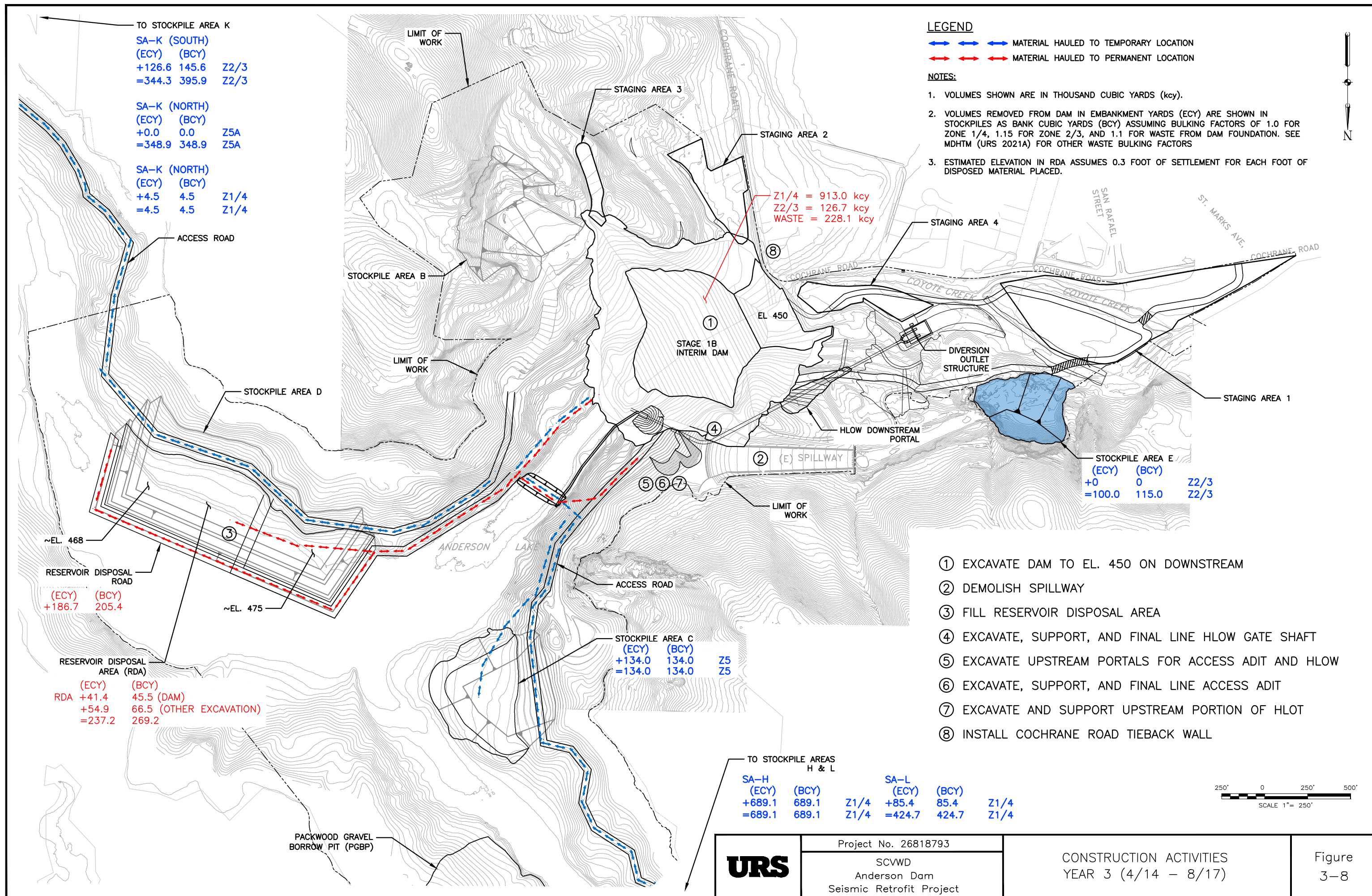
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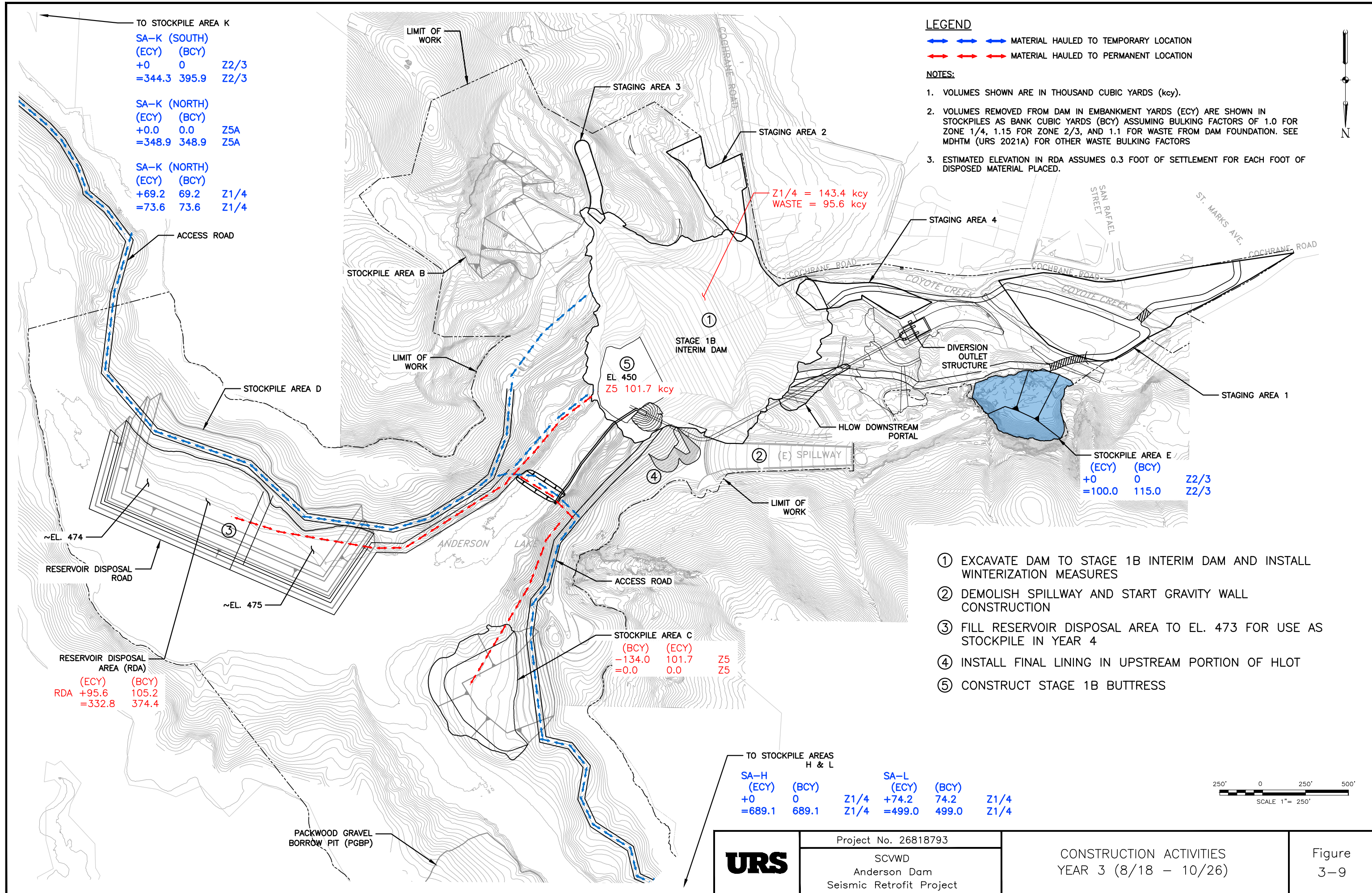


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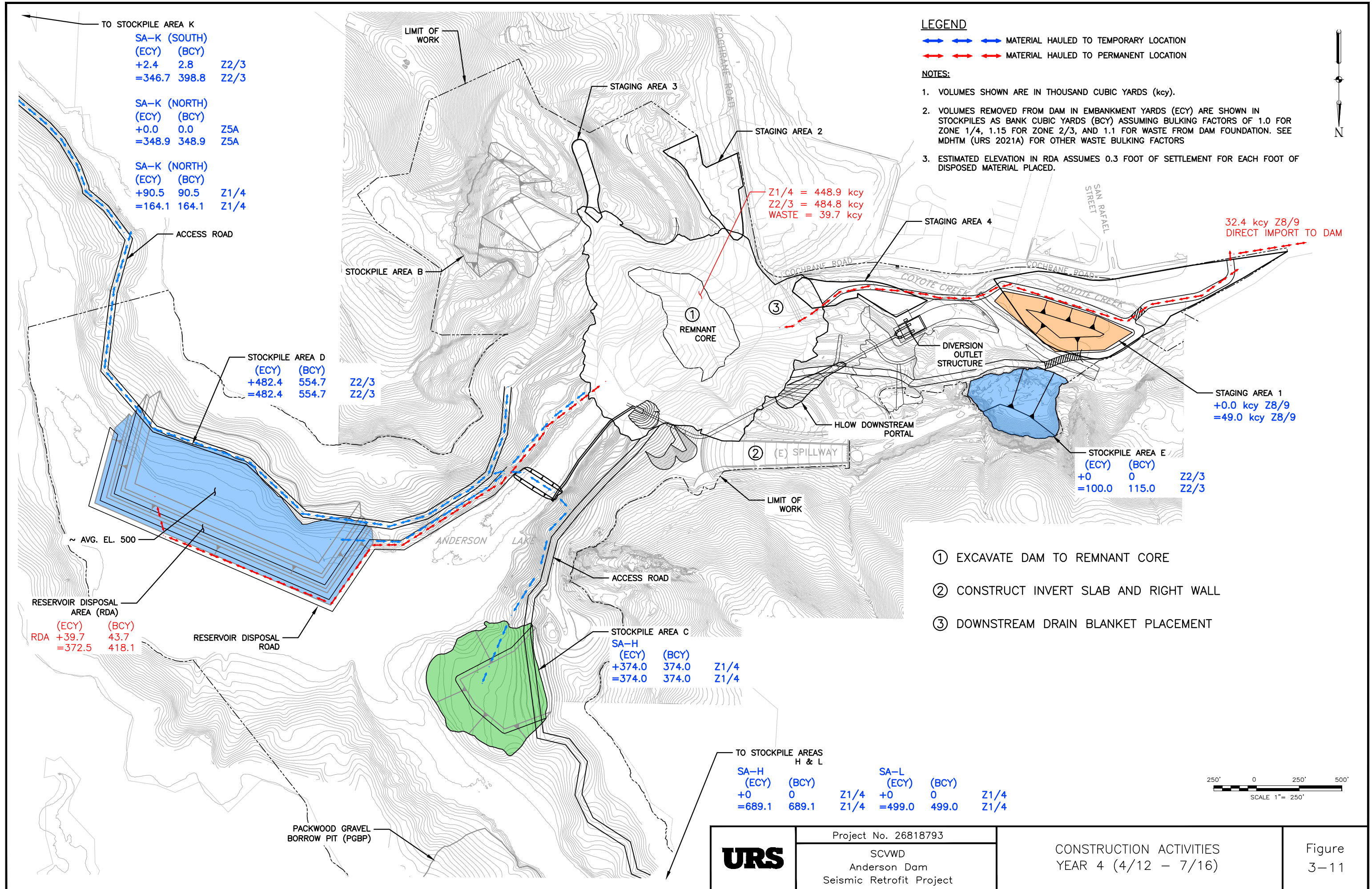


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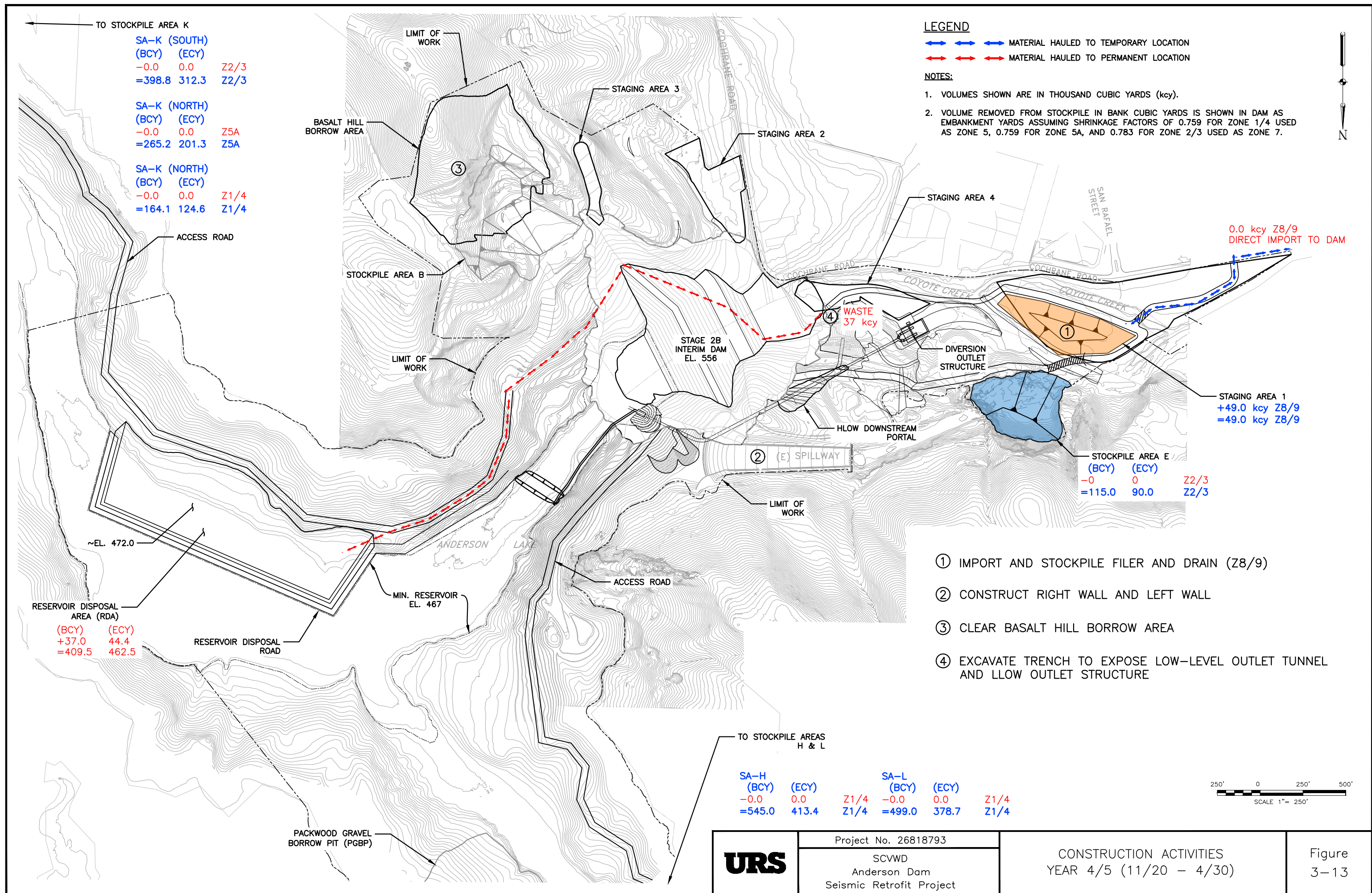


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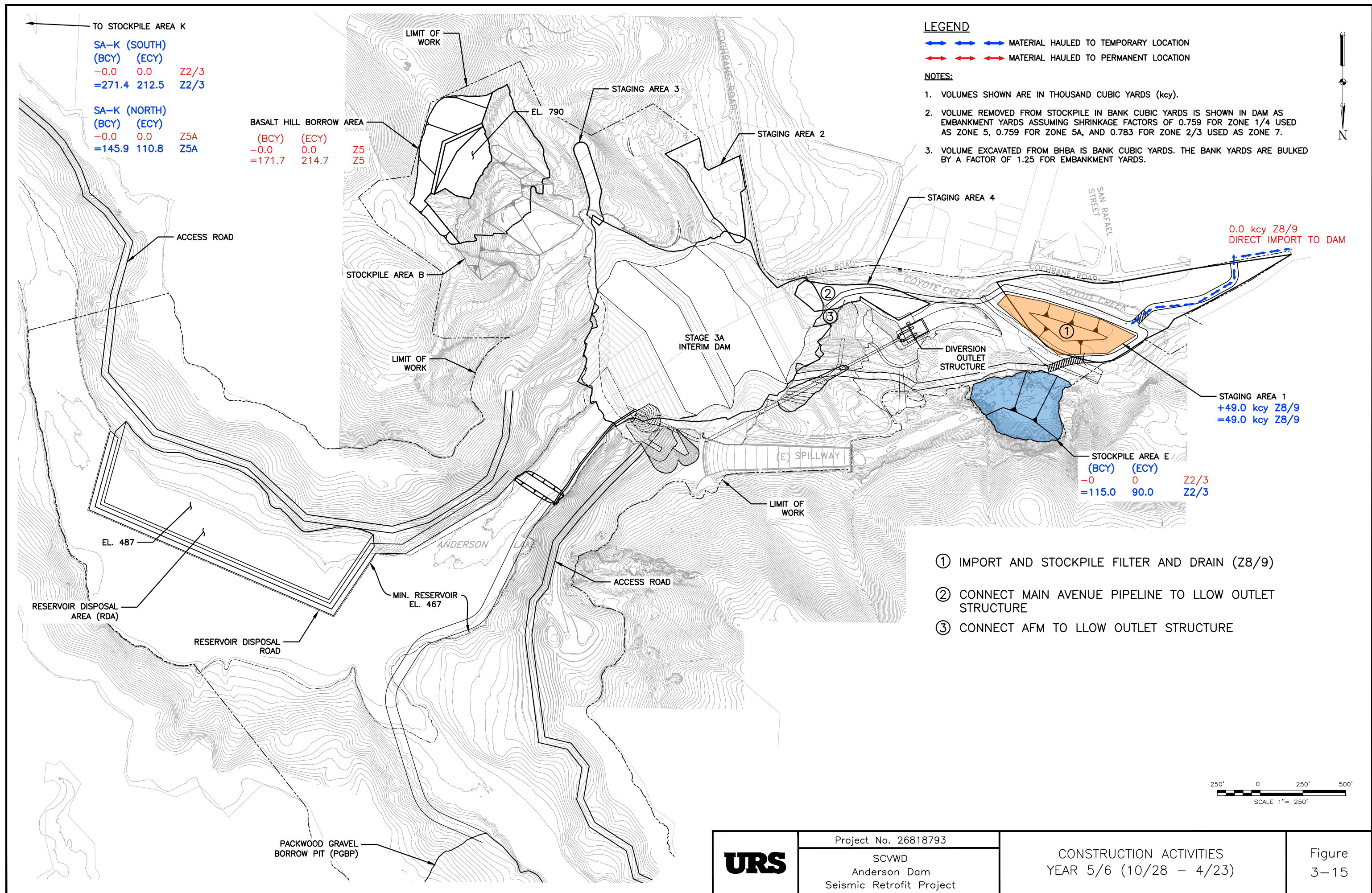


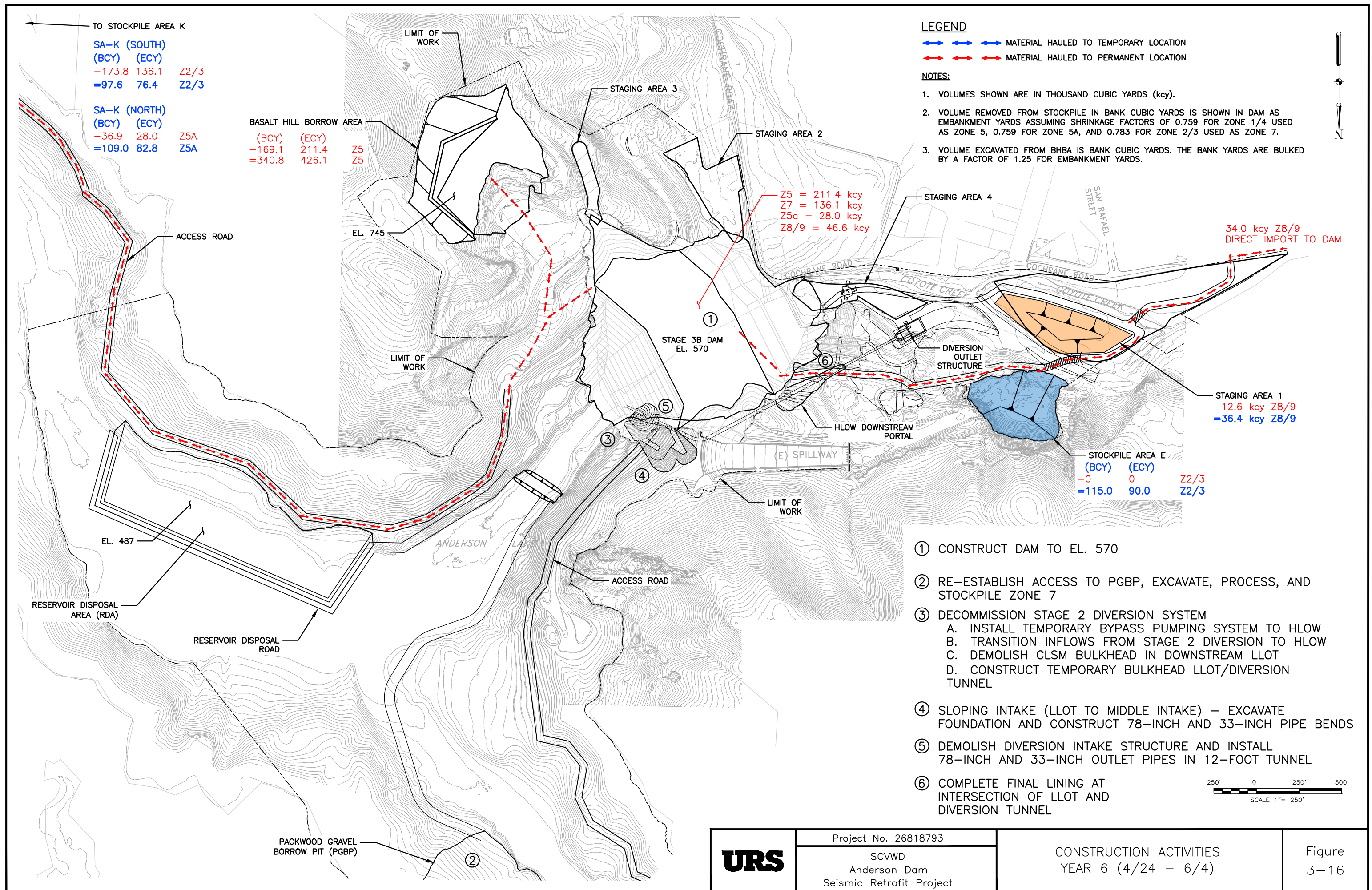
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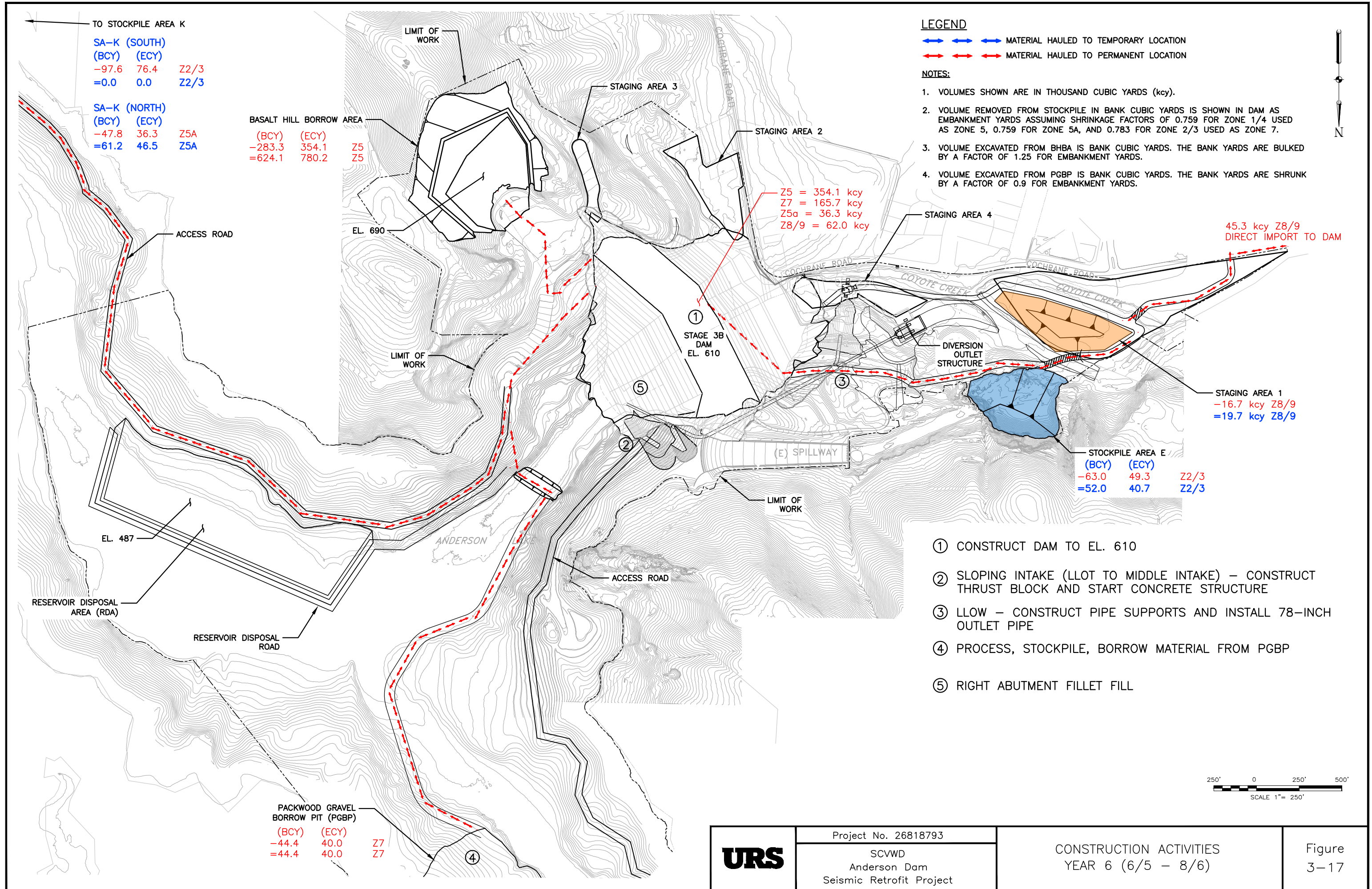


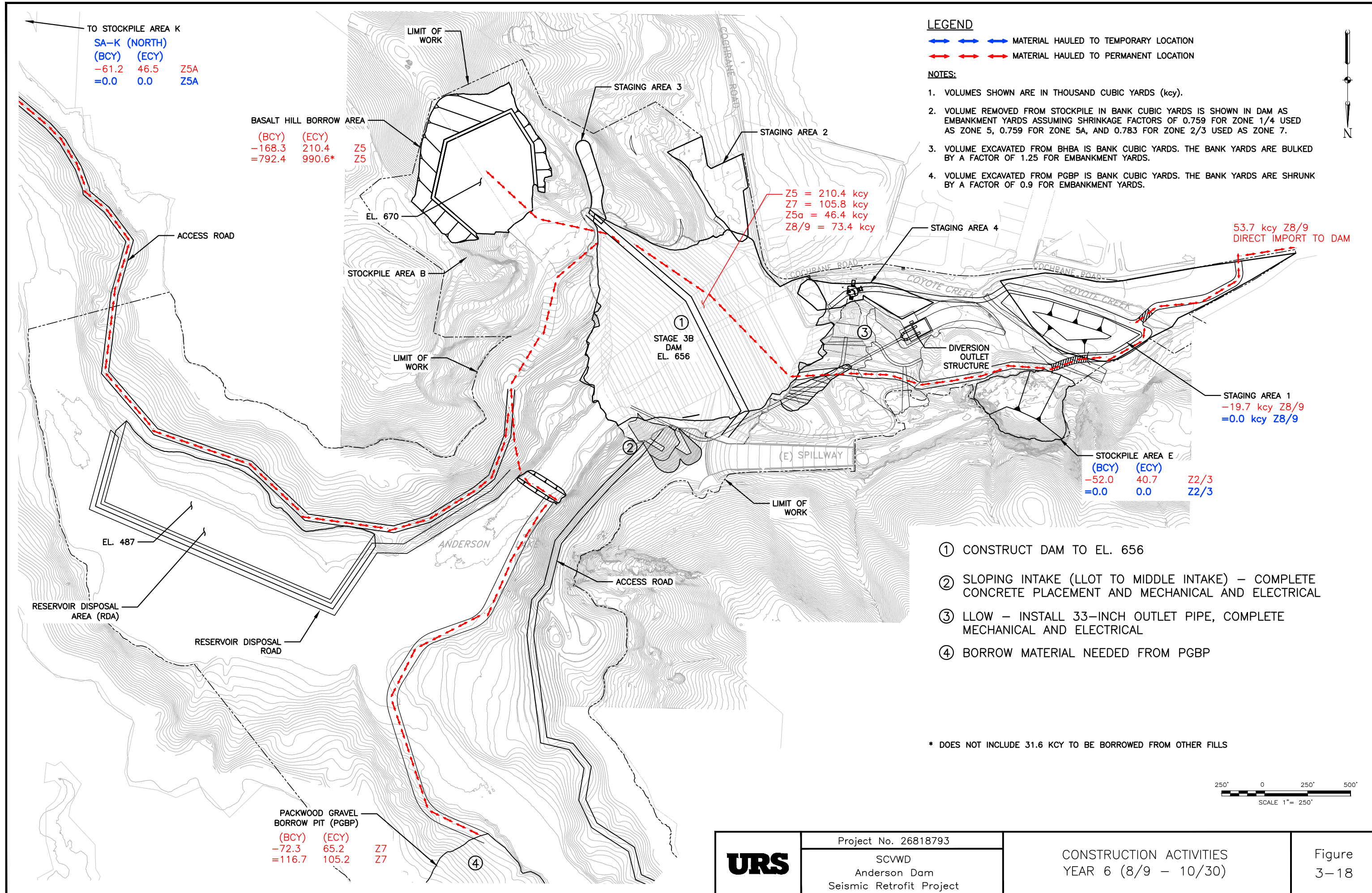
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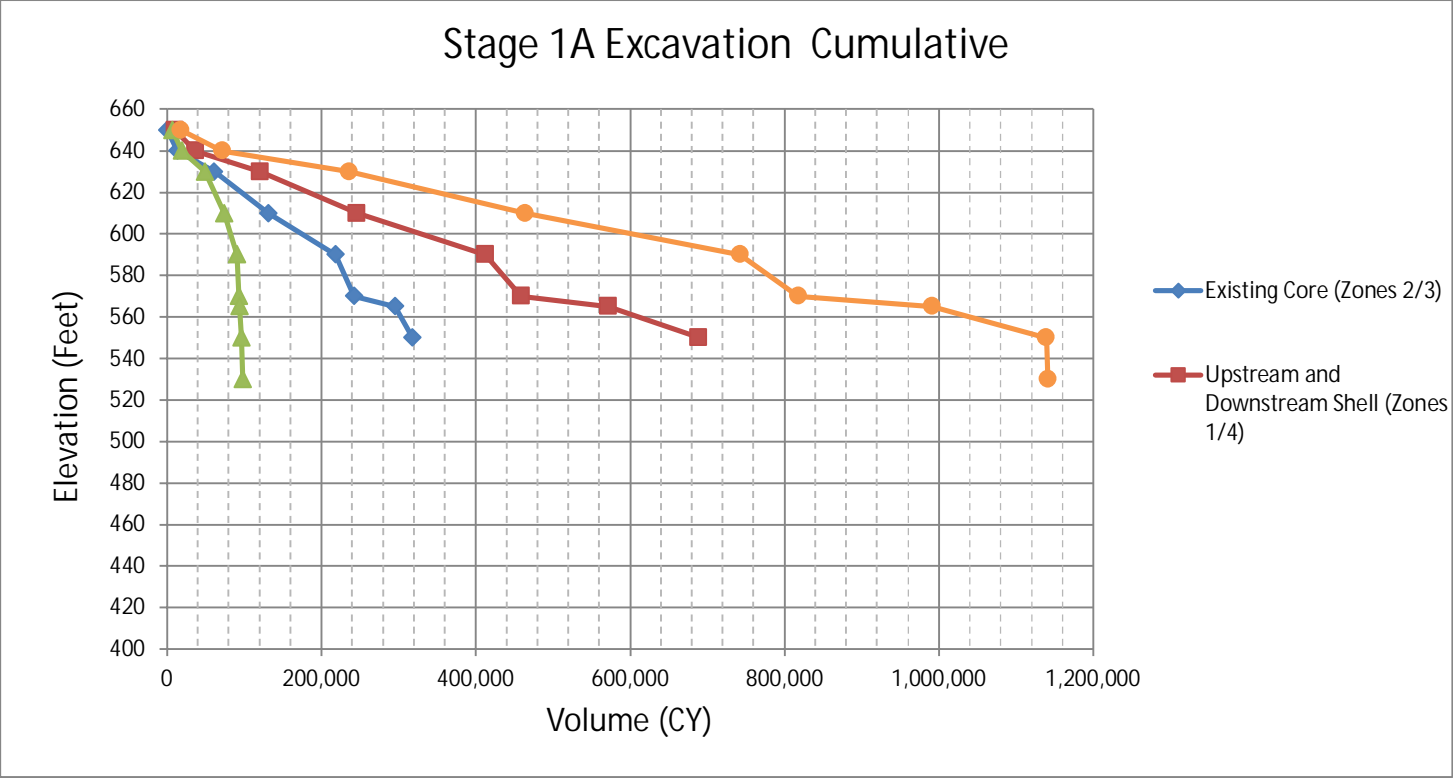
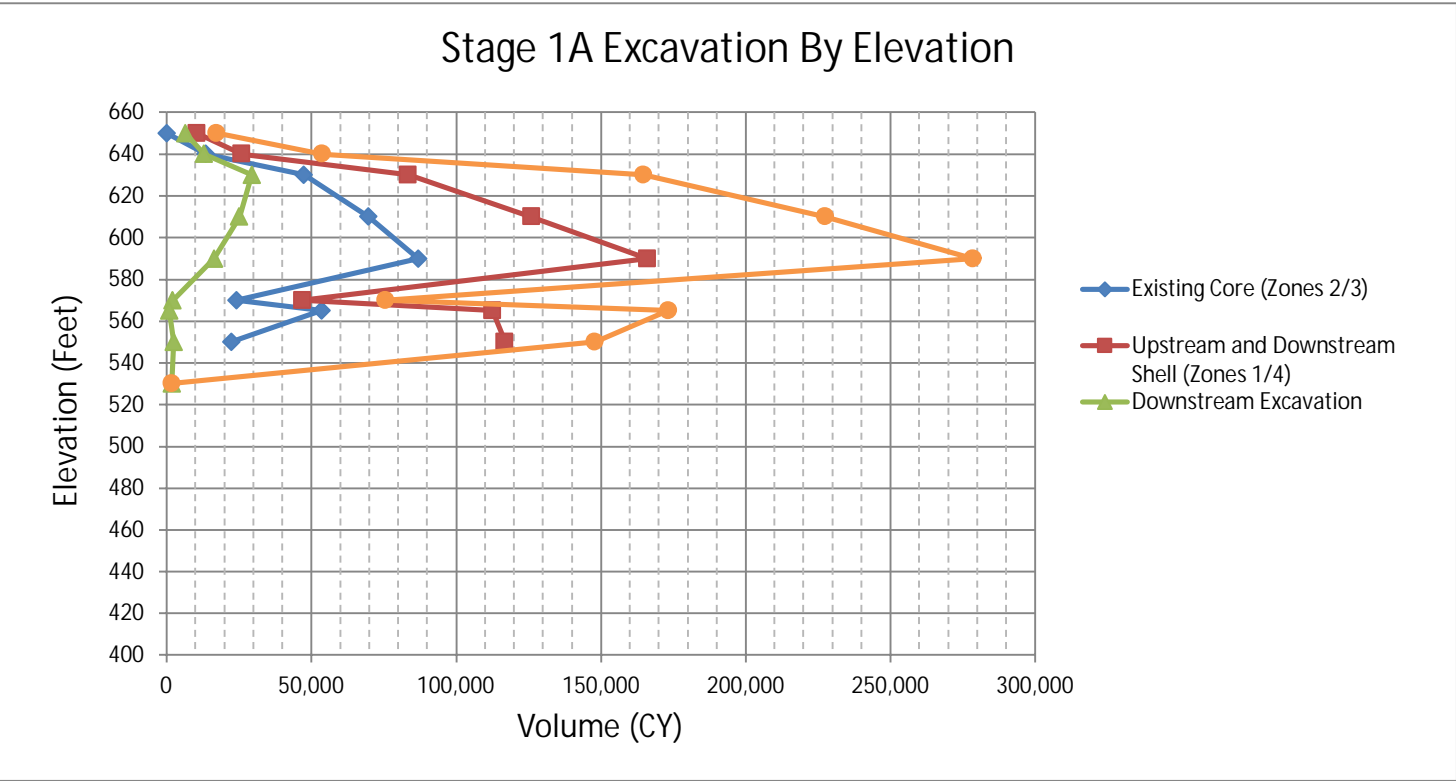
Appendix A: ADSRP Excavation and Fill Hauling Production Analysis

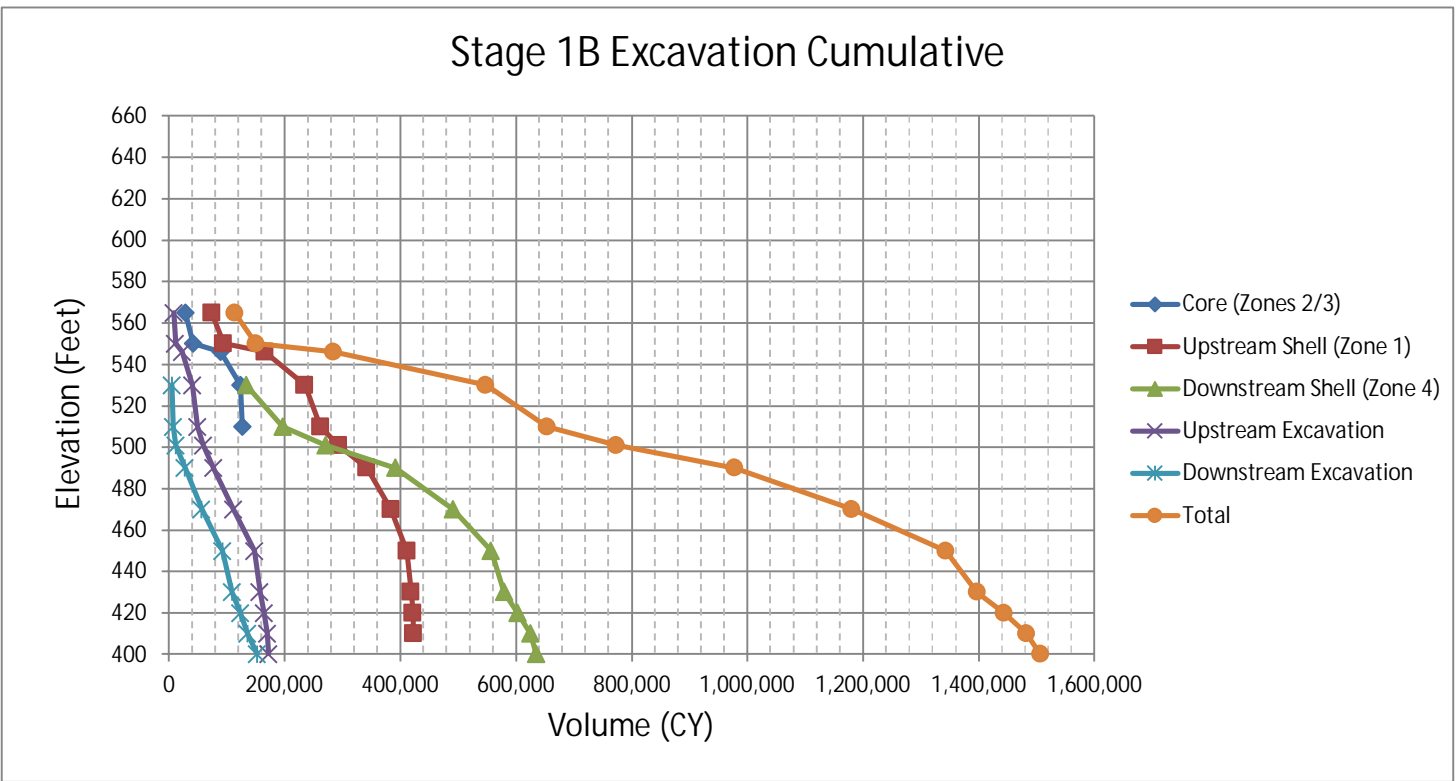
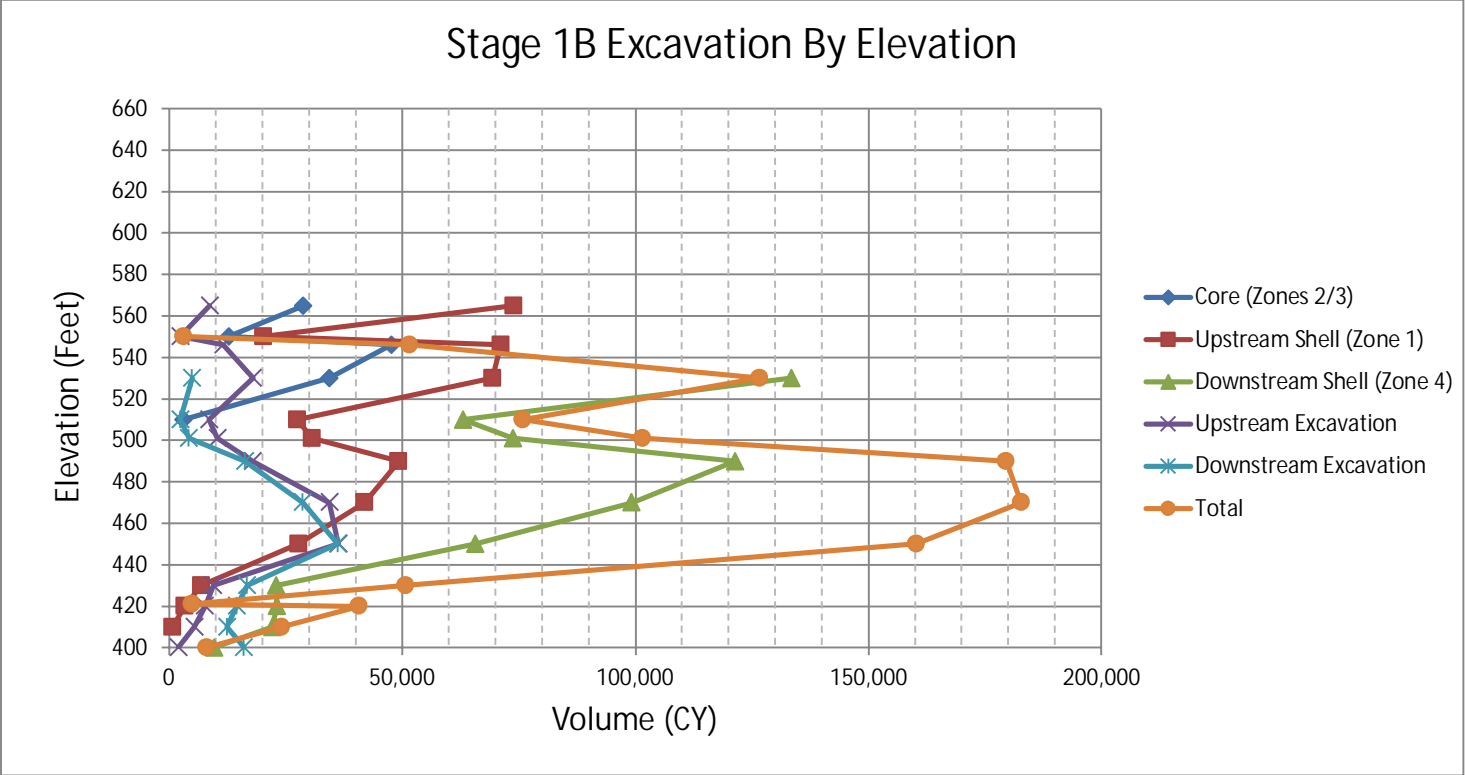
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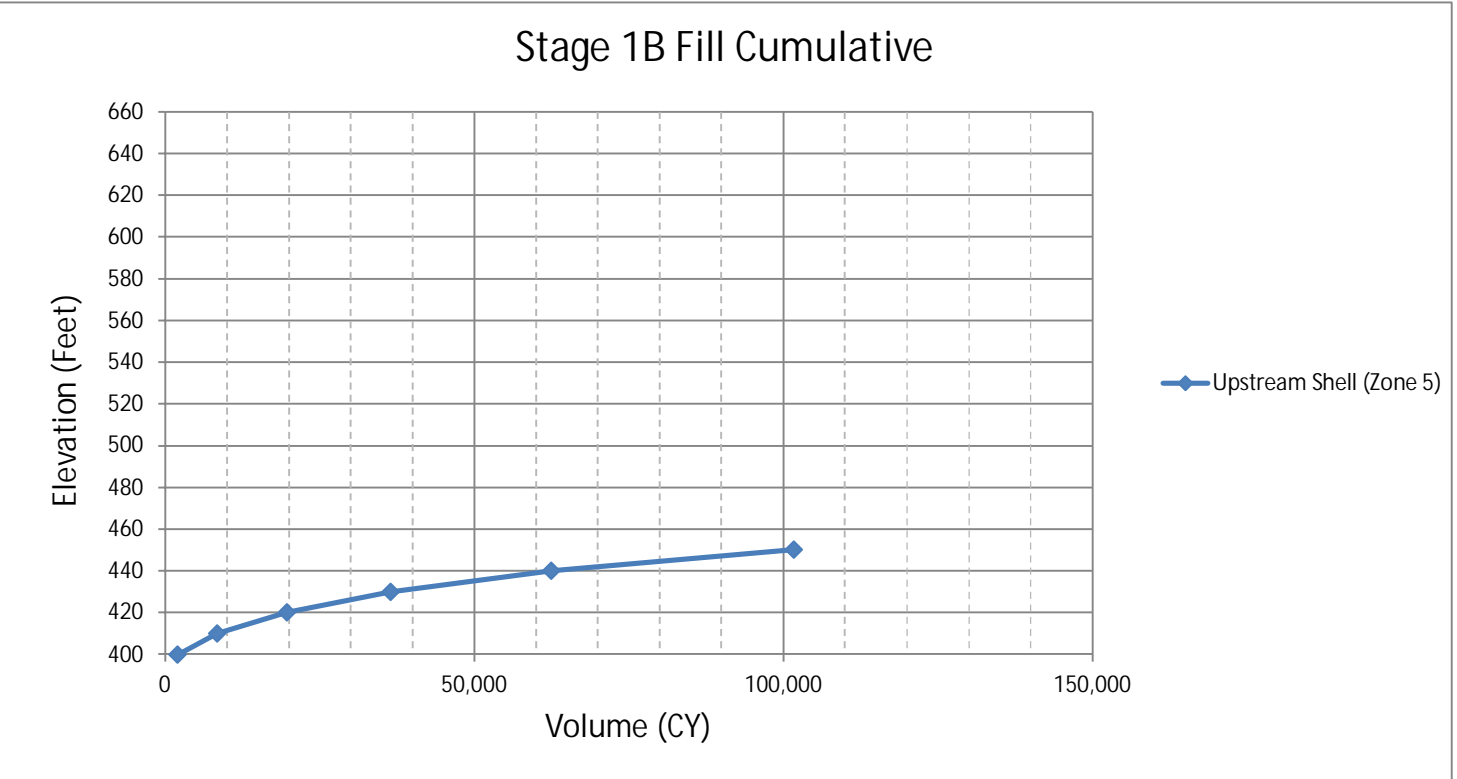
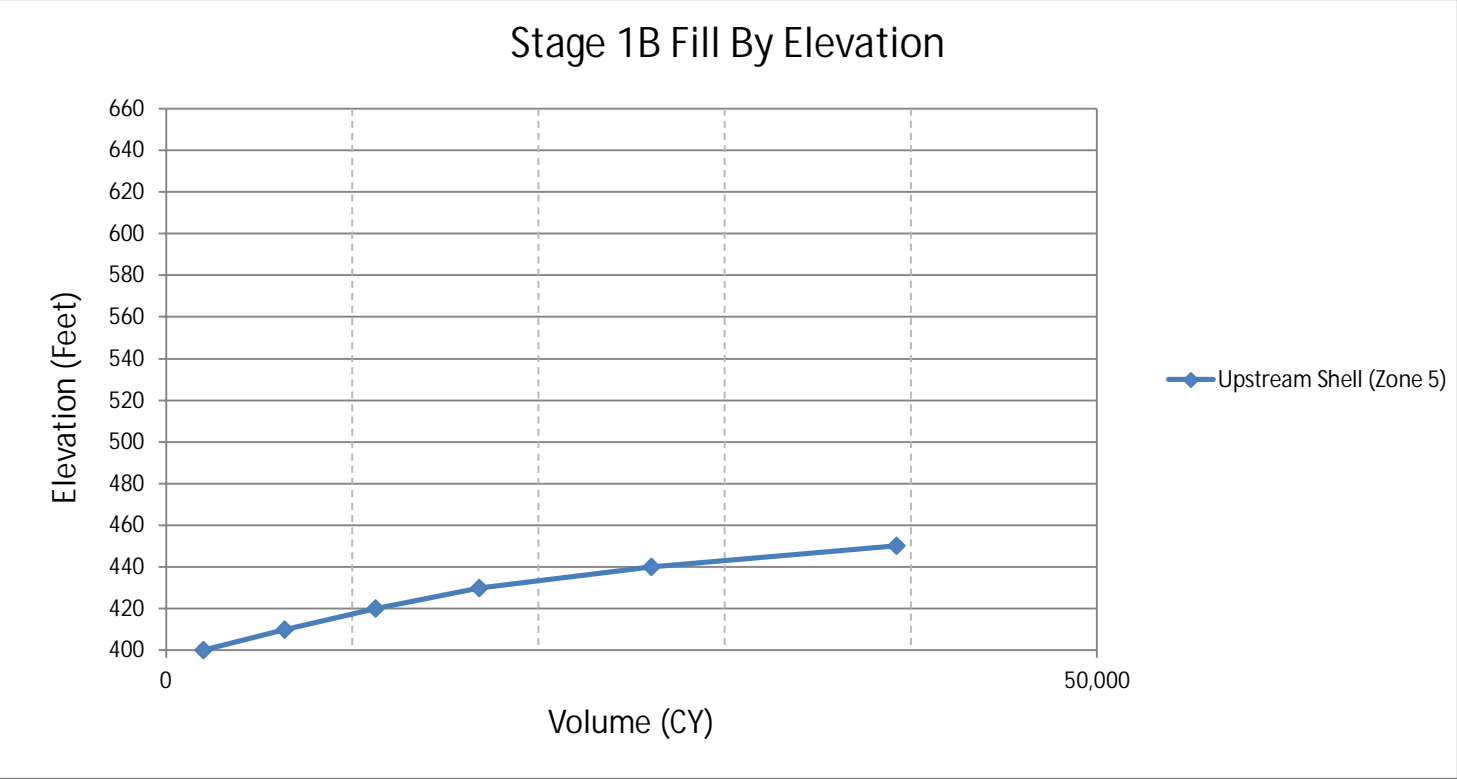
Anderson Dam Seismic Retrofit Project: Excavation and Embankment Fill Hauling Analysis																		5/28/2021			
Volumes are embankment yards														Assumptions:		duration:		weeks	shift/day:		2 shifts
														days/week:	5 days		hours/shift:		9 hours (effective)		
Stage	Zone 1	Zone 2/3	Zone 4	Foundation	Zone 5 us	Zone 5a us	Zone 8	Zone 7	Zone 8/9	Zone 5a ds	Zone 5 ds	Total	Work Days	Prod Rate	Prod Rate	Prod Rate/crew	Prod Rate/crew	Prod Rate/crew	Prod Rate/crew		
	(cy)	(cy)	(cy)	(cy)	(cy)	(cy)	(cy)	(cy)	(cy)	(cy)	(cy)	(cy)	(days)	(cy/day)	(cy/hour)	(cy/day)	(cy/hour)	(cy/day)	(cy/hour)		
Stage 1a Excavation	229,428	317,685	458,751	97,786								1,103,650	105	10511	584	5255	292	3504	195		
Crest to El. 630	18,258	13,651	18,258	19,461								69,628	10.0	6963	387	3481	193	2321	129		
El. 630 to El. 610	41,740	47,457	41,740	29,573								160,511	11.5	13957	775	6979	388	4652	258		
El. 610 to El. 590	63,011	69,737	63,011	25,077								220,836	15.5	14247	792	7124	396	4749	264		
El. 590 to El. 570	83,010	87,019	83,010	16,375								269,414	19.0	14180	788	7090	394	4727	263		
El. 570 to El. 565	23,408	24,064	23,408	2,138								73,019	5.0	14604	811	7302	406	4868	270		
El. 565 to El. 530		75,758	229,324	4,197								309,278	44.0	7029	391	3515	195	2343	130		
	229,428	317,685	458,751	96,821								1,102,686	105	10502	583	5251	292	3501	194		
Stage 1b Excavation	422,254	126,603	634,221	323,631								1,506,709	136	11079	615	5539	308	3693	205		
Upstream to Bottom																					
El. 565 to El. 530	165,168	41,519		22,499								229,187	33.0	6945	386	3473	193	2315	129		
El. 530 to El. 510	69,348			17,903								87,251	12.0	7271	404	3635	202	2424	135		
El. 510 to El. 490	58,065			18,765								76,829	11.0	6984	388	3492	194	2328	129		
El. 490 to El. 470	49,222			17,814								67,036	9.5	7056	392	3528	196	2352	131		
El. 470 to El. 450	41,871			34,315								76,186	11.0	6926	385	3463	192	2309	128		
El. 450 to El. 430	27,711			36,232								63,943	13.0	4919	273	2459	137	1640	91		
El. 430 to El. 410	10,157			17,009								27,166	7.0	3881	216	1940	108	1294	72		
El. 410 to El. 390	711			7,257								7,968	4.0	1992	111	996	55	664	37		
Downstream to Bottom													100.5								
El. 565 to El. 530		47,691										47,691	6.0	7948	442	3974	221	2649	147		
El. 530 to El. 510		34,355	133,438	4,884								172,676	21.0	8223	457	4111	228	2741	152		
El. 510 to El. 490		3,129	136,780	6,582								146,491	18.0	8138	452	4069	226	2713	151		
El. 490 to El. 470			121,366	16,180								137,546	17.0	8091	449	4045	225	2697	150		
El. 470 to El. 450			99,197	28,622								127,819	16.0	7989	444	3994	222	2663	148		
El. 450 to El. 430			65,711	36,160								101,871	18.0	5659	314	2830	157	1886	105		
El. 430 to El. 410			45,992	31,100								77,091	20.0	3855	214	1927	107	1285	71		
El. 410 to El. 390			31,738	28,310								60,048	20.0	3002	167	1501	83	1001	56		
	422,254	126,694	634,221	323,631								1,506,800	136	11079	616	5540	308	3693	205		

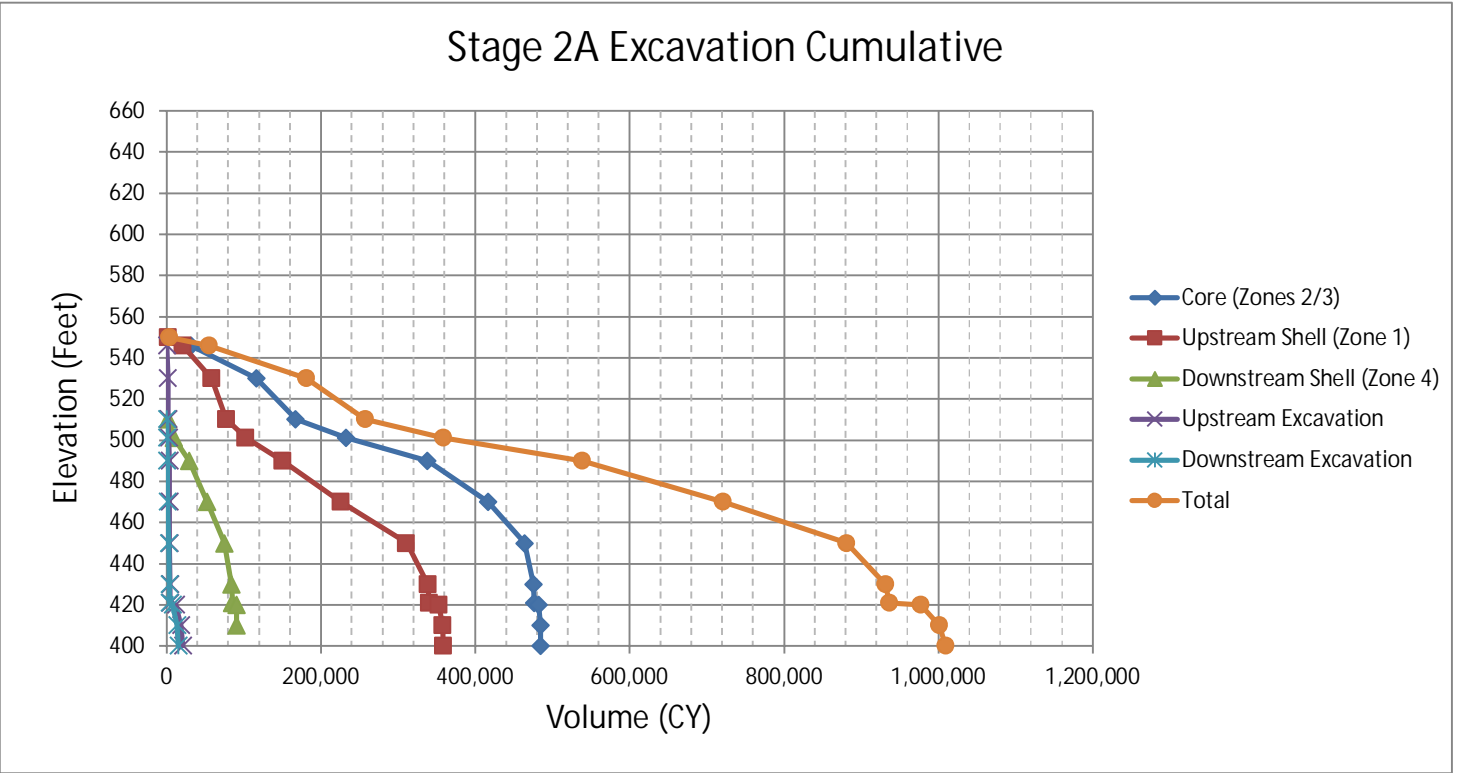
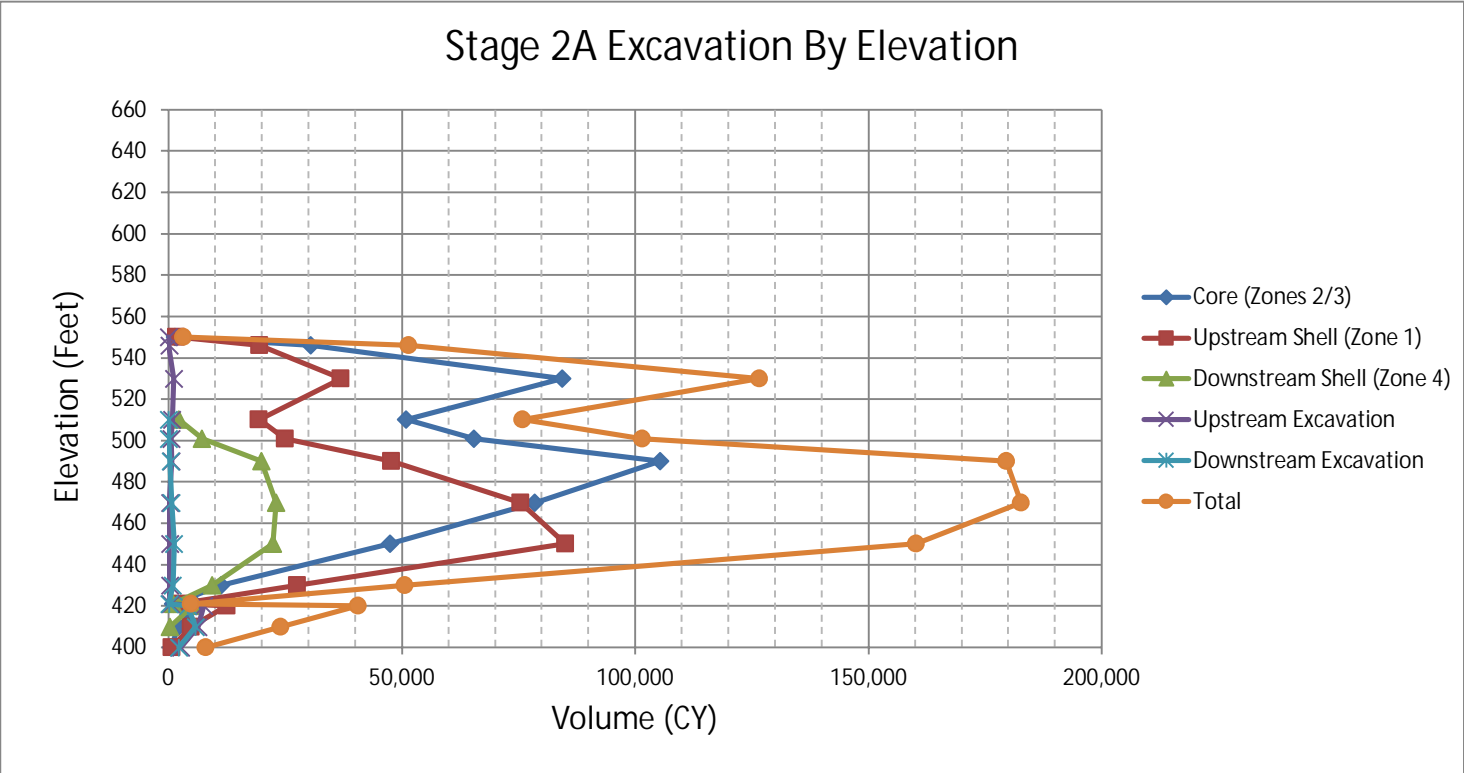
Anderson Dam Seismic Retrofit Project: Excavation and Embankment Fill Hauling Analysis														5/28/2021								
Volumes are embankment yards														Assumptions:		duration:		weeks	shift/day:	2	shifts	
														days/week:		5	days	hours/shift:	9	hours (effective)		
														Assume 1 crew			Assume 2 crews			Assume 3 crews		
Stage	Zone 1	Zone 2/3	Zone 4	Foundation	Zone 5 us	Zone 5a us	Zone 8	Zone 7	Zone 8/9	Zone 5a ds	Zone 5 ds	Total	Work Days	Prod Rate	Prod Rate	Prod Rate/crew	Prod Rate/crew	Prod Rate/crew	Prod Rate/crew			
	(cy)	(cy)	(cy)	(cy)	(cy)	(cy)	(cy)	(cy)	(cy)	(cy)	(cy)	(cy)	(days)	(cy/day)	(cy/hour)	(cy/day)	(cy/hour)	(cy/day)	(cy/hour)			
Stage 1b Fill	101,710												101,710	20	5086	283	2543	141	1695	94		
El. 390 to El. 410	8,355												8,355	6.0	1393	77	696	39	464	26		
El. 410 to El. 430	28,069												28,069	15.0	1871	104	936	52	624	35		
El. 430 to El. 450	65,286												65,286	13.0	5022	279	2511	140	1674	93		
Stage 2a Excavation	358,411	484,765	90,466	36,089									969,731	60.5	16029	890	8014	445	5343	297		
El. 546 to El. 530	21,101	31,830	118										53,049	2.8	18946	1053	9473	526	6315	351		
El. 530 to El. 510	36,942	84,379	1,118										122,439	6.5	18837	1046	9418	523	6279	349		
El. 510 to El. 490	44,375	116,444	9,370	1,353									171,541	9.0	19060	1059	9530	529	6353	353		
El. 490 to El. 470	47,709	105,337	19,901	1,024									173,971	9.0	19330	1074	9665	537	6443	358		
El. 470 to El. 450	75,415	78,535	23,102	865									177,917	9.4	18927	1052	9464	526	6309	351		
Upstream														36.7								
El. 450 to El. 430	85,079	23,713	250										109,042	12.5	8723	485	4362	242	2908	162		
El. 430 to El. 410	42,278	9,125	8,244										59,647	8.0	7456	414	3728	207	2485	138		
El. 410 to El. 390	5,575	1,281	8,928										15,784	5.0	3157	175	1578	88	1052	58		
Downstream														25.5								
El. 450 to El. 430		23,713	22,363	1,182									47,258	5.5	8592	477	4296	239	2864	159		
El. 430 to El. 410		9,125	15,433	5,066									29,624	4.0	7406	411	3703	206	2469	137		
El. 410 to El. 390		1,281	298	7,941			32,441						9,520	3.0	3173	176	1587	88	1058	59		
														12.5								
	358,473	484,765	90,466	36,089									969,793	62.2	15592	866	7796	433	5197	289		
Stage 2B Fill	334,677					33,620	33,620	434,239	135,172	29,909	58,452	1,059,689	70	15138	841	7569	421	5046	280			
Upstream to El. 450																						
Bottom to El. 390	676													676	1	676	38	338	19	225	13	
El. 390 to El. 410	19,314					347	347	1,935						21,942	17	1291	72	645	36	430	24	
El. 410 to El. 430	48,467					1,952	1,952	15,570						67,939	15	4529	252	2265	126	1510	84	
El. 430 to El. 450	77,485					2,623	2,623	43,198						125,928	19	6628	368	3314	184	2209	123	
Downstream to El. 450													52									
Bottom to El. 390									7,547				7,547	4	1887	105	943	52	629	35		
El. 390 to El. 410									36,841				36,841	20	1842	102	921	51	614	34		
El. 410 to El. 416									20,494	6,707			27,201	15	1813	101	907	50	604	34		
El. 416 to El. 430									20,358	6,707	5,789	32,854	10	3285	183	1643	91	1095	61			
El. 430 to El. 450									6,691	6,612	23,321	36,624	11	3329	185	1665	92	1110	62			
El. 450 to El. 556													60									
El. 450 to El. 470	51,570					3,323	3,323	75,653	8,629	7,910	23,300	173,708	9.2	18881	1049	9441	524	6294	350			
El. 470 to El. 490	38,064					4,223	4,223	93,827	2,171	1,973	6,042	150,522	8	18815	1045	9408	523	6272	348			
El. 490 to El. 510	37,415					5,282	5,282	87,470					135,450	7.1	19077	1060	9539	530	6359	353		
El. 510 to El. 530	33,607					6,398	6,398	70,764					117,168	6.2	18898	1050	9449	525	6299	350		
El. 530 to El. 550	23,628					7,196	7,196	41,360					79,381	9	8820	490	4410	245	2940	163		
El. 550 to El. 556	4,452					2,276	2,276	4,463					13,467	1.5	8978	499	4489	249	2993	166		
														41								
	334,677	33,620	33,620	434,239	135,172	29,909	58,452	1,027,248						101	10171	565	5085	283	3390	188		

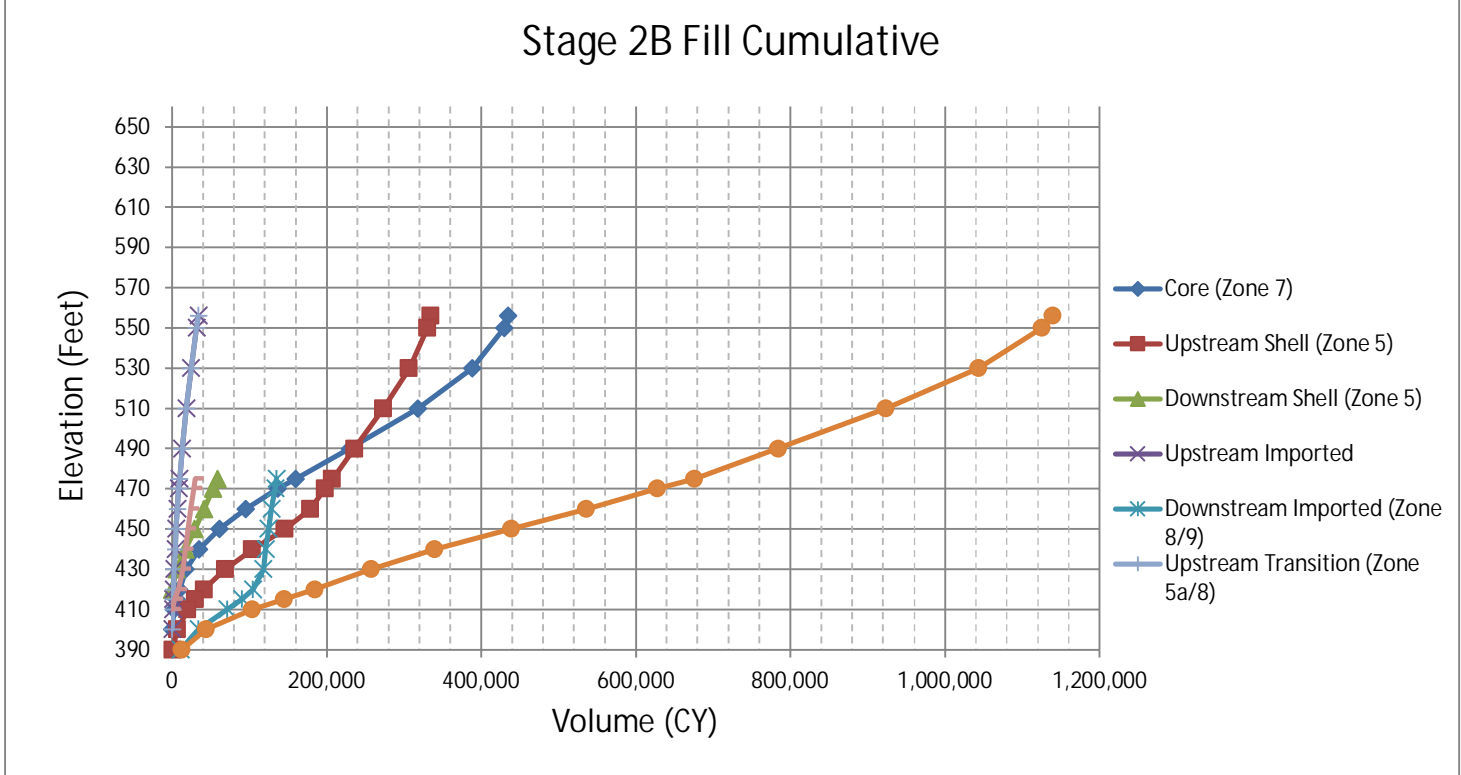
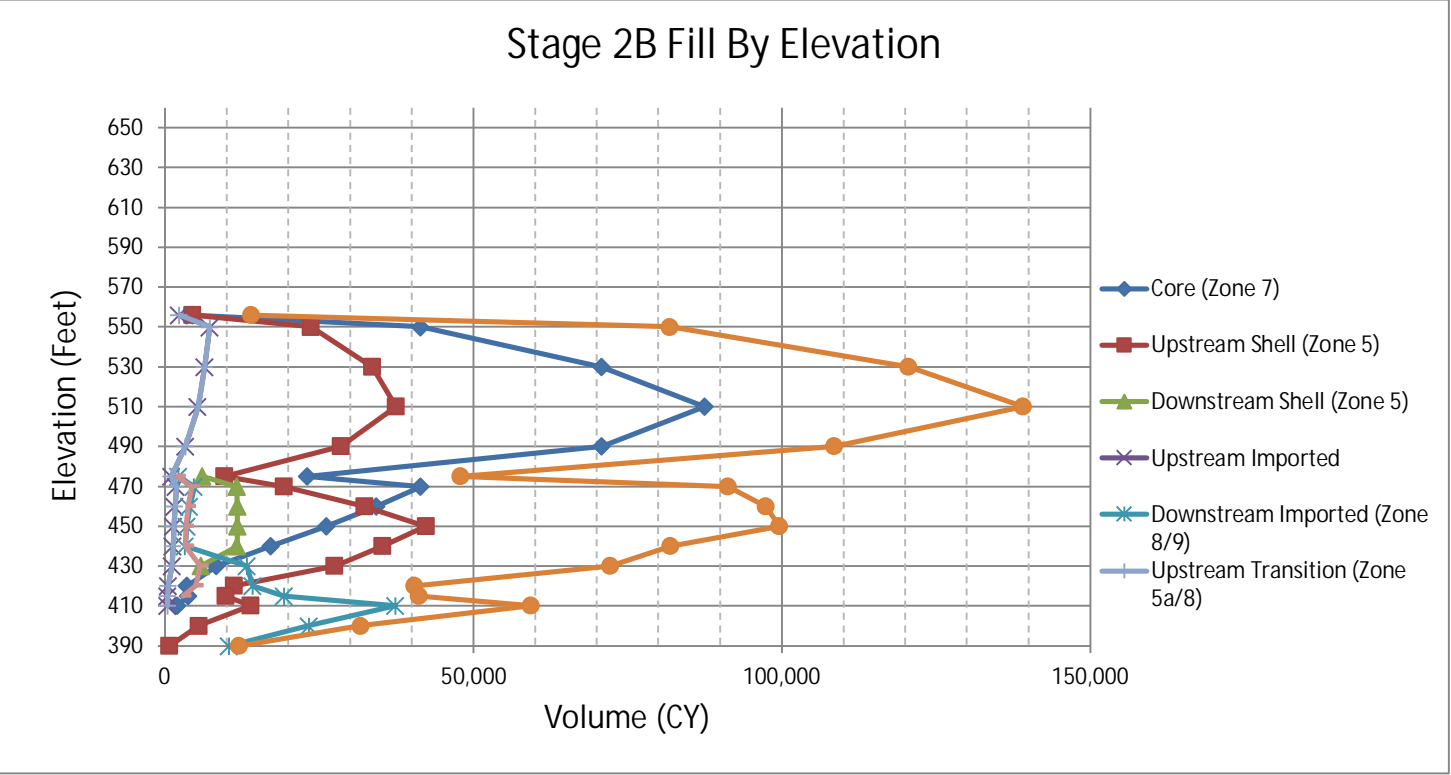
Anderson Dam Seismic Retrofit Project: Excavation and Embankment Fill Hauling Analysis																		5/28/2021				
Volumes are embankment yards														Assumptions:		duration:		weeks	shift/day:	2	shifts	
														days/week:	5	days	hours/shift:	9	hours (effective)			
														Assume 1 crew							Assume 2 crews	
Stage	Zone 1	Zone 2/3	Zone 4	Foundation	Zone 5 us	Zone 5a us	Zone 8	Zone 7	Zone 8/9	Zone 5a ds	Zone 5 ds	Total	Work Days	Prod Rate	Prod Rate	Prod Rate/crew	Prod Rate/crew	Prod Rate/crew	Prod Rate/crew			
	(cy)	(cy)	(cy)	(cy)	(cy)	(cy)	(cy)	(cy)	(cy)	(cy)	(cy)	(cy)	(days)	(cy/day)	(cy/hour)	(cy/day)	(cy/hour)	(cy/day)	(cy/hour)			
Stage 3A Fill	697,5923,5053,50599,803128,10287,029433,9671,453,504													122	11914	662	5957	331	3971	221		
Upstream to El. 565																						
El. 450 to El. 470	76,04276,042													11	6913	384	3456	192	2304	128		
El. 470 to El. 490	112,066112,066													16	7004	389	3502	195	2335	130		
El. 490 to El. 510	121,241121,241													17.5	6928	385	3464	192	2309	128		
El. 510 to El. 530	131,195131,195													18.5	7092	394	3546	197	2364	131		
El. 530 to El. 550	139,841139,841													20	6992	388	3496	194	2331	129		
El. 530 to El. 565	117,206117,206													17	6894	383	3447	192	2298	128		
Downstream to El. 565														100								
El. 410 to El. 430	29,97429,974													4.5	6661	370	3330	185	2220	123		
El. 430 to El. 450	11,1137,10659,29977,518													11	7047	392	3524	196	2349	131		
El. 450 to El. 470	23,97615,08367,200106,259													15	7084	394	3542	197	2361	131		
El. 470 to El. 490	4,32828,98019,00297,814150,124													21	7149	397	3574	199	2383	132		
El. 490 to El. 510	20,85331,54422,24194,180168,818													24	7034	391	3517	195	2345	130		
El. 510 to El. 530	42,24232,49023,59785,499183,828													26	7070	393	3535	196	2357	131		
El. 530 to El. 550	17,65617,656													10	1766	98	883	49	589	33		
El. 550 to El. 565	3,5053,50514,72521,735													12	1811	101	906	50	604	34		
	697,592	3,505	3,505	99,803	128,102	87,029	433,967	1,453,504	122	11914	662	5957	331	3971	221							
Stage 3B Fill	432,34644,44644,446407,591137,50666,278343,5381,476,151													110	13420	746	6710	373	4473	249		
El. 530 to El. 550	52,51225,48314,71484,652177,362													13.0	13643	758	6822	379	4548	253		
El. 550 to El. 570	35,2752,0952,09583,59619,01711,14591,437244,661													17.0	14392	800	7196	400	4797	267		
El. 570 to El. 590	130,3658,8468,84688,04421,3988,47365,376331,348													23.0	14406	800	7203	400	4802	267		
El. 590 to El. 610	112,4629,7949,79477,66421,9139,16345,950286,741													20.0	14337	797	7169	398	4779	266		
El. 610 to El. 630	86,87011,14811,14862,69623,83310,61731,718238,029													17.0	14002	778	7001	389	4667	259		
El. 630 to El. 650	53,9859,9719,97136,86921,1939,95818,877160,825													15.0	10722	596	5361	298	3574	199		
El. 650 to El. 657	13,3892,5922,5926,2094,6692,2075,52837,185													5.0	7437	413	3719	207	2479	138		
	432,346	44,446	44,446	407,591	137,506	66,278	343,538	1,476,151	110.0	13420	746	6710	373	4473	249							

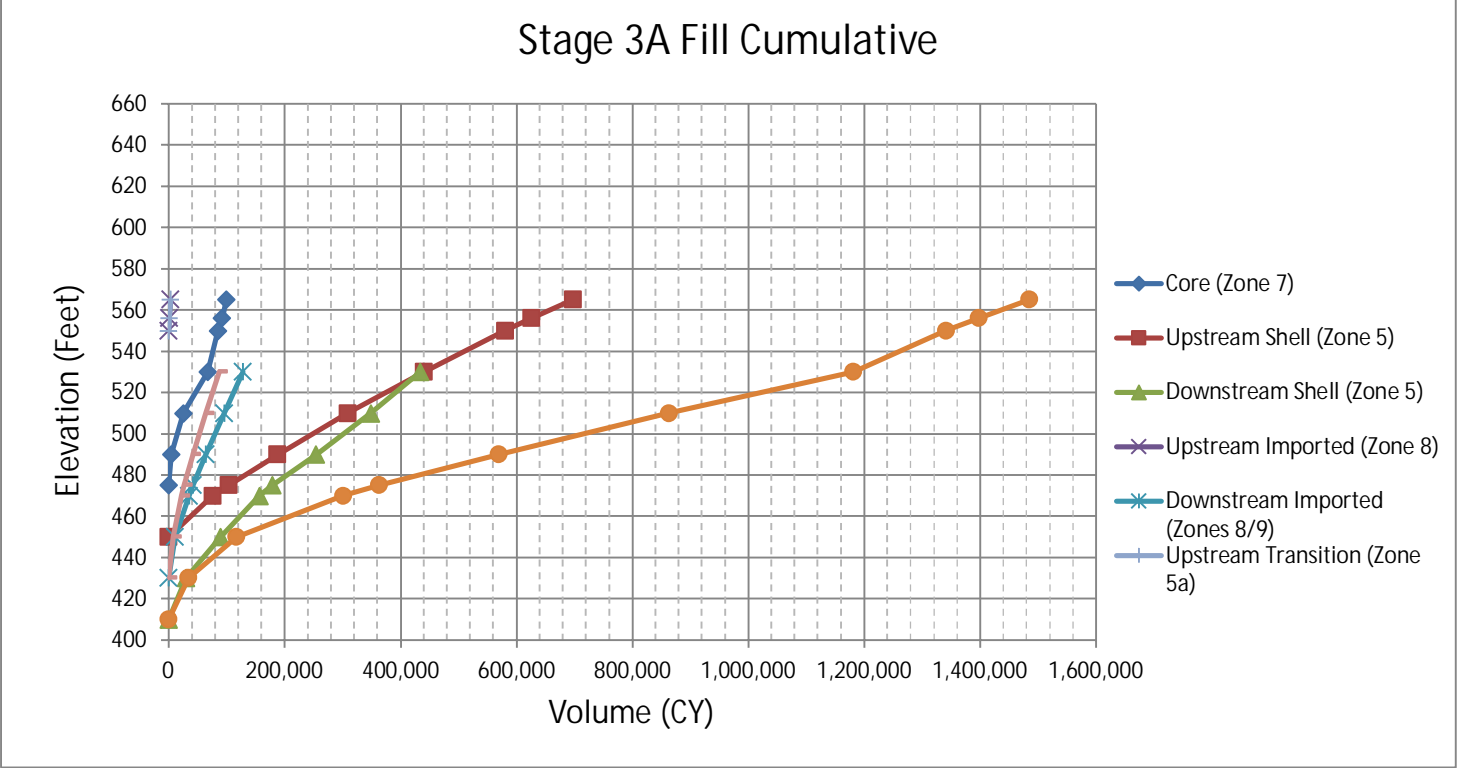
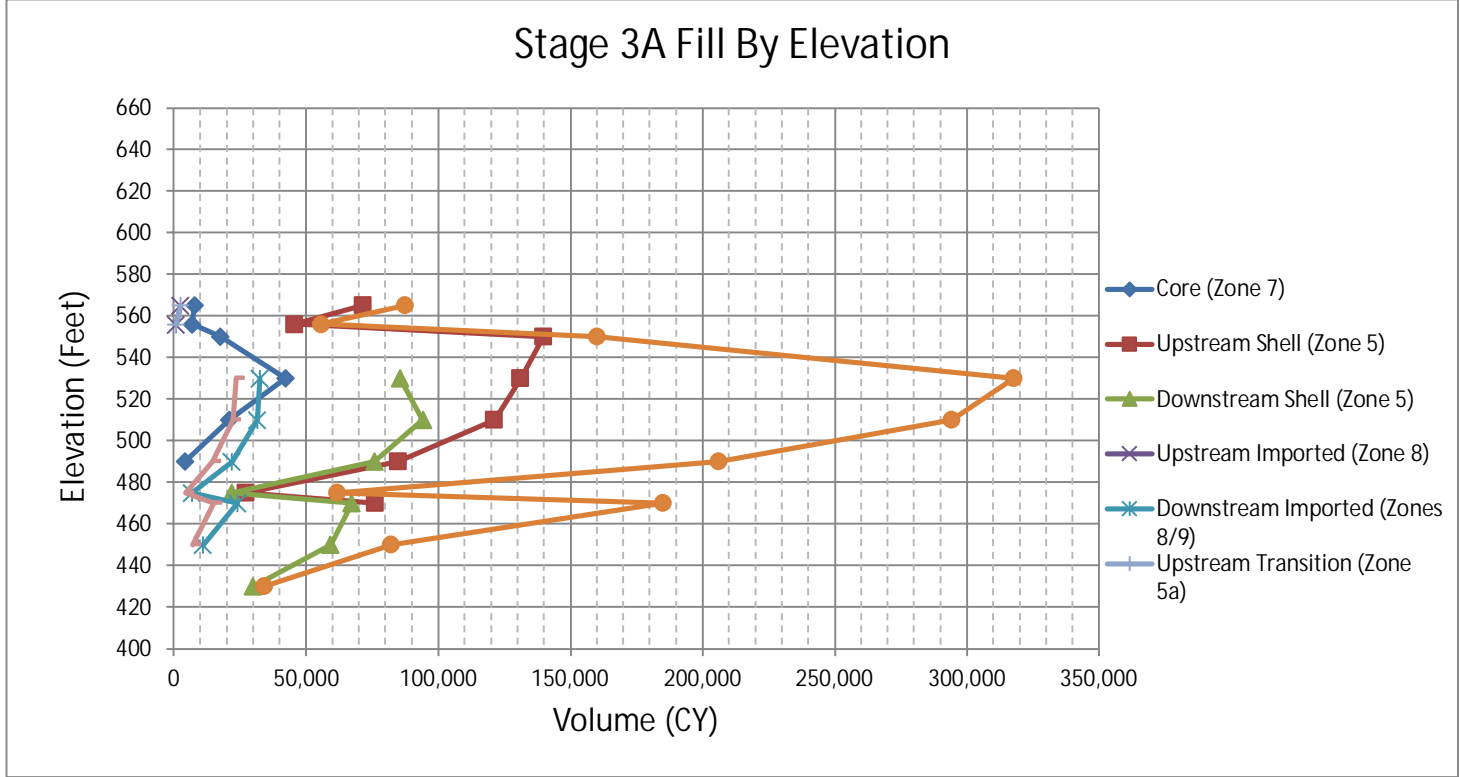


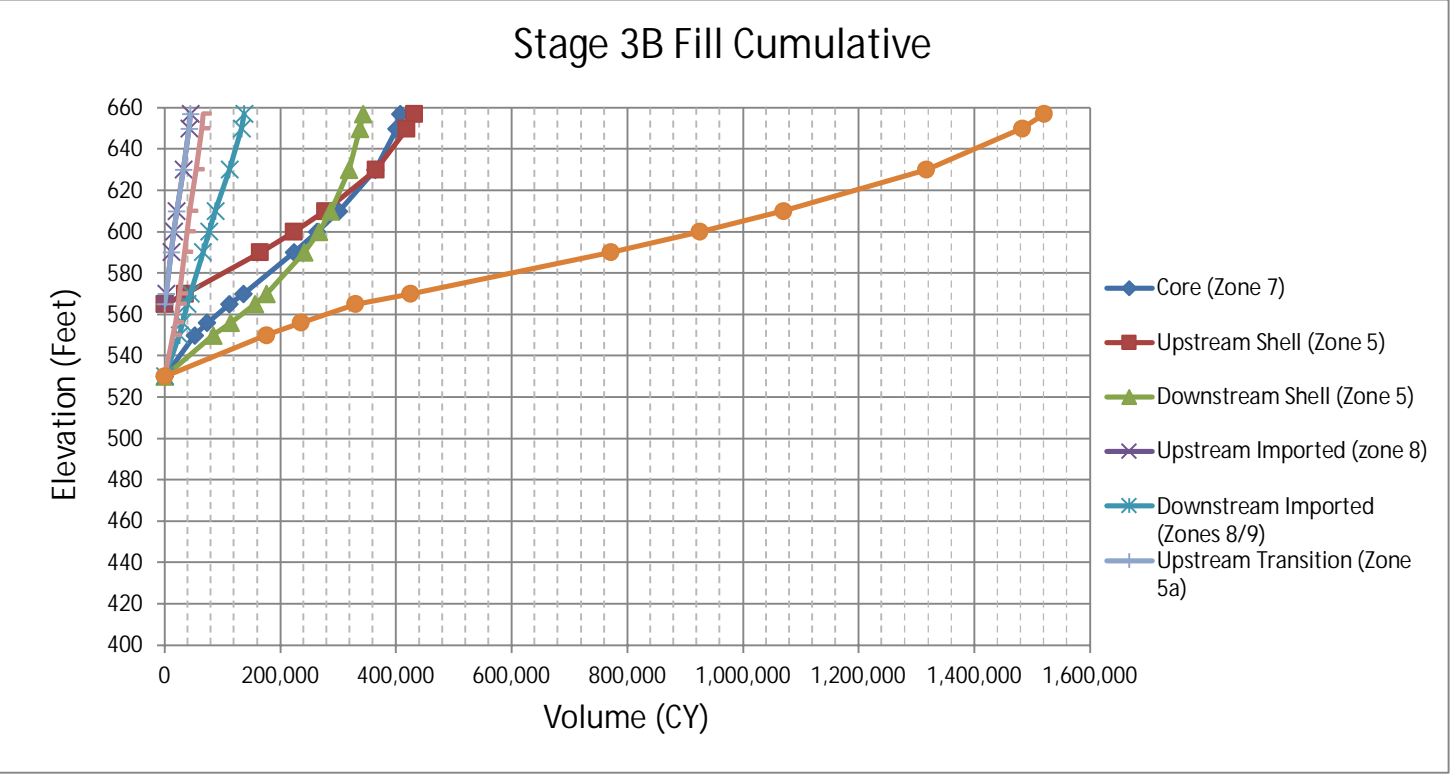
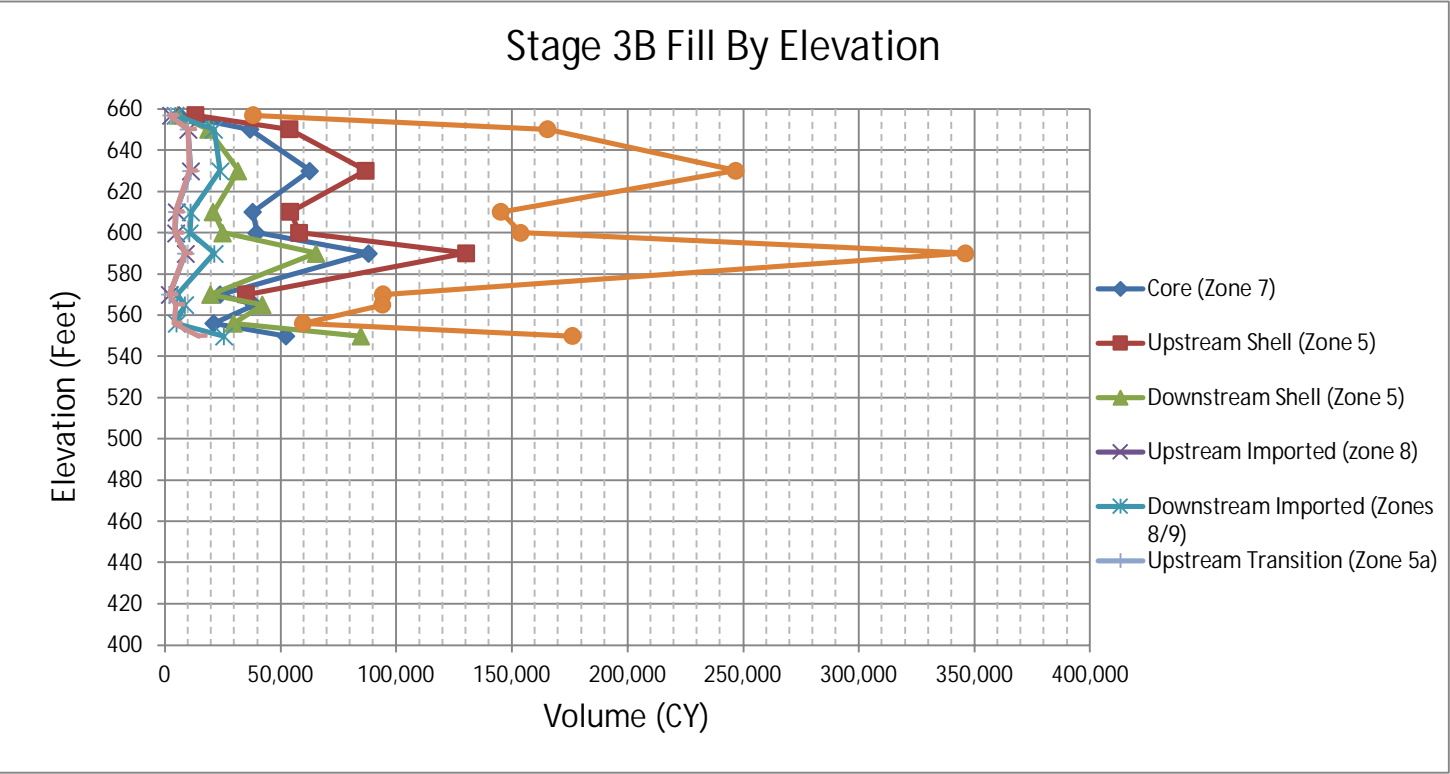












Appendix B: Detailed Analysis of Stage 1B Buttress Fill, End of Stage 2a Excavation, and Start of Stage 2b Fill

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Figure B-17	Stage 2b Fill Areas Below El. 450 Feet

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B1 INTRODUCTION

An area of significant risk for construction of the ADSRP will be the effort required during Year 4 when:

- Stage 2a Excavation removes the Stage 1b interim dam down to the remnant core,
- The foundation is prepared for initiation Stage 2b Fill, and
- Stage 2b Fill constructs the Stage 2b interim dam.

The most difficult portion of the Year 4 work will be that required below about El. 450 where the working area becomes more constrained. Although not as critical from a schedule standpoint, a similar constrained working area occurs during Year 3 when excavating below E. 450 in the upstream dam foundation and then backfilling with compacted Zone 5 shell material to buttress the Stage 1b interim dam. An analysis of the effort required for foundation excavation, preparation, and embankment construction was undertaken to evaluate the potential duration required for the work below El. 450.

B2 ANTICIPATED FOUNDATION CONDITIONS

During construction of the original dam, the bottom of the valley was excavated to bedrock for the core foundation. Contours in the valley bottom from as-built surveys of the excavated foundation are shown on Figure B-1. Also shown on Figure B-1 are the limits of the existing core foundation and the locations of field investigation borings. As shown on Figure B-1, the lowest area of the foundation occurs at the upstream edge of the existing core at about El. 384. The foundation level at the downstream edge of the core is about El. 404 feet. Photographs of the inspection of the foundation surface by DSOD in 1950 are shown as follows:

- Figure B-2 – From upstream looking downstream. The photograph is taken from the top of the cut and is estimated to be at about El. 402 feet.
- Figure B-3 – From left abutment looking toward rock rib extending from right abutment.
- Figure B-4 – From left abutment looking upstream and toward rock rib extending from right abutment.

The photographs shown in Figures B-2, B-3, and B-4 are not taken from a perspective that clearly shows the downstream extent of the core foundation.

Following inspection and approval of the foundation, the low area in the foundation was filled in with compacted core materials as shown on Figures B-5, B-6, B-7, and B-8. Two borings (DH 9-29 and DH 9-29SPT; see Figure B-1) were drilled in 2009 at the upstream end of the low area (URS 2021a). Both borings found core material at about El. 400 feet.

The downstream boring (DH 9-29) was in core material until bedrock was encountered at El. 390 feet. The upstream boring (DH 9-29SPT) encountered 2.5 feet of core then 3 feet of alluvium before hitting rock at El. 396 feet.

The bridge that was abandoned and buried in the downstream shell of the dam can be seen in the background of the photograph shown on Figure B-2. The bridge, just prior to burial is shown on Figures B-9, B-10, and B-11.

B3 FOUNDATION EXCAVATION

Figure B-12 shows the end of Stage 1b Excavation (prior to placing the Zone 5 buttress) and end of Stage 2a Excavation. As shown on Figure B-12, the deck of the abandoned bridge under the downstream shell is anticipated to be exposed during Stage 1b Excavation. Demolition of the exposed bridge would be performed prior to starting Stage 2a Excavation to reduce the effort required in preparing the downstream shell foundation for Stage 2b Fill.

On the upstream side of the remnant core, the excavation would be carried down to El. 400 where the core-filled low area will be left in-place (see Figure B-13). The alluvium upstream of the core-filled hole will be excavated to bedrock as shown in section on Figure B-13.

The working areas upstream and downstream of the Stage 1b interim dam for elevations below 450 feet are illustrated on Figure B-14 for excavation and Figure B-15 for placement of the Zone 5 upstream buttress. The working areas upstream and downstream of the remnant core for elevations below 450 feet are illustrated on Figures B-16 (excavation) and B-17 (fill). Figures B-14 through B-17 also include machine turning clearance circles for two types of trucks; a CAT 773 rigid body off-highway truck, and a CAT 740 articulated off-highway truck. Based on the turning clearance circles, it is our opinion that the larger CAT 773's could be used during Stage 2a excavation at elevations greater than 410 feet and the more maneuverable, smaller CAT 740's would be used below El. 410 feet. The smaller CAT 740's would be used below El. 450 feet for Stage 1b excavation on the more constrained upstream side of the Stage 1b interim dam. Based on these assumptions, the time required for Stage 1b Excavation below El. 450 feet is estimated to require about 25 days upstream of the Stage 1b interim dam (see Table B-1). The time required for Stage 2a Excavation below El. 450 feet is estimated to require about 25 days upstream of the remnant core and 13 concurrent days downstream of the remnant core (see Table B-2).

B4 FOUNDATION DEWATERING, CLEANING, AND TREATMENT

During original construction, seepage into the foundation was relatively small (see Figures B-3, B-4, and B-5). Seepage into the Stage 1b and Stage 2a Excavations may be greater than occurred during the original construction due to water that has seeped into and been stored in the abutments. A system of sumps and dewatering trenches may need to be constructed to control groundwater seeping from the abutments and valley bottom as the excavation progresses and to construct the Stage 1b Buttress and Stage 2b Fill. A rock drain that was installed in the valley bottom at the left abutment under the Zone 3 core (see Figure B-15) to handle persistent seepage during original construction will be treated using a sump as shown on Sheet C-211 (URS 2018) during Stage 2b Fill.

Cleaning for the upstream shell foundation (Zone 5 Foundation on Sheet C-214, URS 2018) and the downstream blanket foundation (Zone 8 Foundation on Sheet C-214, URS 2018) will require removing most loose material from the rock foundation using excavators with a maximum 3-foot wide bucket with a smooth blade. The effort required to perform an initial cleaning for the shell on the abutments assumed that on the average each excavator could scrape and clean a 10-foot long strip every 2 minutes. One-half of that effort was estimated for final shell cleaning. Each excavator would be supported by a crew of laborers that would move loose materials from areas not accessible to the excavator bucket. The foundation would be trimmed during excavation to minimize the amount of hand labor required. Initial shell foundation cleaning of the abutments would be performed during Stage 1b Excavation as the outer shells are removed and during Stage 2a Excavation as the inner shells are removed. Final shell cleaning of the abutments would be performed as the embankment is placed.

During both Stage 1b and Stage 2a Excavation below El. 450, the time required to perform initial cleaning on the abutments of the shell foundations is estimated to require 1 to 2 days for each 10 feet of elevation concurrent with the excavation using one excavator upstream of the remnant core and one excavator downstream of the remnant core, which is less than the time required for excavation. Shell cleaning of the valley bottom (one cleaning only prior to shell placement) is estimated to require one week using at two excavators upstream and two excavators downstream of the remnant core.

Cleaning of the rock foundation for new core and the upstream and downstream chimney filters (Zone 7 Foundation on Sheet C-214, URS 2018) after machine removal of most of the loose material will require a combination of hand tools, vacuums, and air/water jets. Treatment of discontinuities in the rock foundation for the new core and filter will require removal of loose material from the discontinuities and filling with dental concrete or slush grout depending on the size of the discontinuity. The effort required for final cleaning of the core and filter foundation is judged to be less than required for the shell due to the small area of foundation (primarily a strip for Zone 8 filter material) below El.

450 feet that will need to be cleaned at the upstream and downstream edges of the remnant core.

B5 EMBANKMENT CONSTRUCTION

Stage 1b Fill will construct a Zone 5 buttress on the upstream side of the Stage 1b interim dam (Sheet C-206, URS 2021b). Stage 2b Fill upstream and downstream of the remnant core differs significantly (Sheet C-221, URS 2021b). Upstream of the remnant core, the majority of the fill to be placed will be shell (Zone 5) material with relatively small volumes of core (Zone 7) and filter (Zone 8). Downstream of the remnant core, the majority of the fill to be placed is filter (Zone 8) and drain (Zone 9), transition (Zone 5a) with relatively small volumes of core (Zone 7) and shell (Zone 5).

B5.1 STAGE 1B BUTTRESS UPSTREAM OF STAGE 1B INTERIM DAM

Stage 1b Fill requires placement of shell (zone 5) to construct the buttress at the upstream side of the Stage 2b interim dam as shown on Figure B-15.

The working areas upstream of the Stage 1b interim dam for elevations below 450 feet is illustrated on Figure B-15. Figure B-15 also includes machine turning clearance circles for two types of trucks: a CAT 773 rigid body off-highway truck and a CAT 740 articulated off-highway truck. Stage 1b Fill is assumed to be placed using articulated trucks due to the confined available space.

Shell materials would be placed in the valley bottom from the interim dam to the upstream end of the dam using articulated trucks, spread with bulldozers and compacted parallel to the dam axis. This productivity analysis assumes that each lift is completely placed prior to compaction and that compaction occurs without any fill being placed (i.e. no concurrent placement and compaction). As shown in Table B-3, approximately 7 weeks (working 2 shifts 5 days per week) is required to reach El. 450.

B5.2 STAGE 2B FILL UPSTREAM OF CORE REMNANT

Embankment construction in the area upstream of the core remnant shown on Figure B-16 will include placement of four zones: shell (Zone 5), transition (Zone 5a), filter (Zone 8), and core (Zone 7).

The working areas upstream of the remnant core for elevations below 450 feet are illustrated on Figure B-17. Figure B-17 also includes machine turning clearance circles for two types of trucks: a CAT 773 rigid body off-highway truck and a CAT 740 articulated off-highway truck.

Core, filter, and transition materials will be likely placed in the constricted area below about El. 410 using loaders and will be spread using a small bulldozer. As shown on Figure B-13, the width of new core will be a minimum of 7 feet wide to allow placement of 12-inch loose lifts and compaction using a pad-foot roller with a 7-foot-wide, 12-ton drum (CAT CP76 or similar). The single drum roller would be used until the width of core widens sufficiently (about El. 410) for effective use of a CAT 825 tamping foot roller. Filter materials would be placed in 12-inch loose lifts and compacted using a vibratory smooth drum roller with a 7-foot-wide, 12-ton drum (CAT CS76 or similar).

Shell materials would be placed in the valley bottom from the upstream filter to the upstream end of the dam using articulated trucks, spread with bulldozers and initially compacted in the upstream/downstream direction up to El. 410 feet after which the direction of placement and compaction would shift to parallel to the dam axis. Larger rigid body trucks are assumed for placement of shell materials above El. 410.

This productivity analysis assumes that two operations will be occurring at the same time: placement of Zone 7, Zone 8, and Zone 5a at the area of the remnant core; and placement of Zone 5 across the upstream shell foundation. For both operations, it is assumed that each lift is completely placed prior to compaction and that compaction occurs without any fill being placed (i.e. no concurrent placement and compaction). Table B-4 is a summary of the analysis and Table B-5 shows the details of the analysis. As shown in Table B-4, placement and compaction of the shell materials (Zone 5) will control the rate at which the embankment rises on the upstream side of the remnant core. As shown in Table B-4, approximately 10.5 weeks (working 2 shifts 5 days per week) is required to reach El. 450.

B5.3 STAGE 2B FILL DOWNSTREAM OF CORE REMNANT

Embankment construction downstream of the core remnant will primarily include placement of core (Zone 7), filter (Zone 8), drain (Zone 9), and transition (Zone 5a) with smaller volumes of shell (Zone 5) as shown in section on Sheet C-221 (URS 2021b). To facilitate construction in the valley bottom, the width of new core at the base of the chimney will be detailed to have a minimum width of 7 feet similar to what is shown on Figure B-13 on the upstream side of the remnant core.

Placement of approximately the downstream third of the drain blanket including the core (Zone 7) barrier and construction of the inspection well (IW-1) is assumed to start concurrent with Stage 2a Excavation (see Figure B-16). The core barrier, the underlying filter, and the filter and drain materials upstream of the barrier will be placed using loaders and spread using a small bulldozer. The width of the core barrier is 15 feet, which will allow placement of 12-inch loose lifts and compaction using a padfoot roller with a 7-foot-wide, 12-ton drum (CAT CP76 or similar). Filter and drain materials would be

compacted using a 12-ton drum (CAT CS76 or similar) vibratory roller. The time required to construct the downstream third of the drain blanket has not been detailed since there is sufficient time within the 15 weeks shown on Figure 3-2 of the CSP for Stage 2a Excavation to complete this work.

The working areas downstream of the remnant core and upstream of the downstream third of the drain blanket for elevations below 450 feet are illustrated on Figure B-17.

Filter and drain materials placed in the upstream of two-thirds of the drain blanket are assumed to be placed using highway legal dump trucks with a 16 CY capacity given the horizontal dimensions of the chimney zones (10 feet) and drain blanket zones (range from about 12 feet to 25 feet) on the abutments and the relatively flat area in the valley bottom. The filter and drain materials would be spread using a small bulldozer into 12-inch thick loose lifts and compacted using a vibratory smooth drum roller with a 7-foot-wide, 12-ton drum (CAT CS76 or similar).

Core materials would be placed up to El. 425 on the downstream side of the core remnant using a loader with a 4 CY capacity. Above El. 425, core materials are assumed to be placed using CAT 773. The core materials are assumed to be placed in 10-inch loose lifts and compacted below El. 416 using a padfoot roller with a 7-foot-wide, 12-ton drum (CAT CP76 or similar) and a CAT 825 tamping foot roller above El. 416.

Placement of shell materials would not begin until the top of the drain in the valley bottom reaches El. 416. Based on the available area, we have assumed that shell materials will be placed using CAT 773, spread with bulldozers into 12-inch loose lifts and compacted using 6 passes of a CAT 825 followed by 6 passes of a vibratory smooth drum roller with a 7-foot-wide, 12-ton drum (CAT CS76 or similar).

This productivity analysis assumes that all zones will be placed concurrently as the elevation rises. However, within each zone it is assumed that each lift is completely placed prior to compaction and that compaction occurs without any fill being placed (i.e. no concurrent placement and compaction). Table B-6 is a summary of the analysis and Table B-7 shows the details of the analysis. As shown in Table B-6, approximately 12 weeks (working 2 shifts 5 days per week) is required to reach El. 450. Table B-6 also indicates that embankment placement below El. 450 feet on the downstream side of the remnant core is controlled by the filter and drain materials.

B6 REFERENCES

URS. 2018. 60% Preliminary Map and Construction Plan and Specifications. April 30.

URS. 2021a. Geotechnical Data Report – Phases 1 Through 7. June.

URS. 2021b. Embankment Basis of Design Technical Memorandum. May 18.

Table B-1 - ANALYSIS OF STAGE 1B UPSTREAM EXCAVATION (5/20/2021)

UPSTREAM OF REMNANT CORE									
	Equipment								
	24.8 CY Articulated Trucks below El. 410 (Assumes 28.5 cy loose loads with 1.15 factor)								
	1.0 minute time for truck to move into position								
	4 minute cycle time to load CAT 740								
	4.6 CY Hydraulic Excavator (assumes 6 cy loose bucket load with 1.3 factor)								
	0.75 minute cycle time for hydraulic shovel								
	5 total cycle time								
	24.8 CY Articulated Trucks below El. 410 (Assumes 28.5 cy loose loads with 1.15 factor)								
	1.0 minute time for truck to move into position								
	4 minute cycle time to load CAT 740								
	4.6 CY Hydraulic Excavator (assumes 6 cy loose bucket load with 1.3 factor)								
	0.75 minute cycle time for hydraulic excavator								
	5 total cycle time								
	Zones 1 and 2 and foundation		Efficiency	24	-inch lift	Excavation		2 shift	Daily Production
Elev	Area	Volume	Factor	# of Lifts	Avg Vol/lift	per lift	total	total	Rate
(feet)	(ft2)	(cy)	(%)		(cy)	(hrs)	(hrs)	(days)	(cy/day)
450	128347								
430	55157	67964	75%	10	6796	30.5	304.7	15.2	4460.9
410	24253	29411	70%	10	2941	14.1	141.3	7.1	4163.5
400	11079	6543	65%	5	1309	6.8	33.8	1.7	3866.1
390	0	2052	60%	5	410	2.3	11.5	0.6	3568.7

Table B-2 - ANALYSIS OF STAGE 2A EXCAVATION (5/20/2021)

Table B-2 - ANALYSIS OF STAGE 2A EXCAVATION (5/20/2021)																			
	UPSTREAM OF REMNANT CORE										DOWNSTREAM OF REMNANT CORE								
	Equipment 35.7 CY Rigid Body Trucks above El. 410 (assumes 41 cy loose loads with 1.15 factor) 1.0 minute time for truck to move into position 2.9 minute cycle time to load CAT 773 9.2 CY Hydraulic Shovel (assumes 12 cy loose bucket load with 1.3 factor) 0.75 minute cycle time for hydraulic shovel 3.9 total cycle time 24.8 CY Articulated Trucks below El. 410 (Assumes 28.5 cy loose loads with 1.15 factor) 1.0 minute time for truck to move into position 4 minute cycle time to load CAT 740 4.6 CY Hydraulic Excavator (assumes 6 cy loose bucket load with 1.3 factor) 0.75 minute cycle time for hydraulic excavator 5 total cycle time										Equipment 35.7 CY Rigid Body Trucks above El. 410 (assumes 41 cy loose loads with 1.15 factor) 1.0 minute time for truck to move into position 2.9 minute cycle time to load CAT 773 9.2 CY Hydraulic Shovel (assumes 12 cy loose bucket load with 1.3 factor) 0.75 minute cycle time for hydraulic shovel 3.9 total cycle time 24.8 CY Articulated Trucks below El. 410 (Assumes 28.5 cy loose loads with 1.15 factor) 1.0 minute time for truck to move into position 4 minute cycle time to load CAT 740 4.6 CY Hydraulic Excavator (assumes 6 cy loose bucket load with 1.3 factor) 0.75 minute cycle time for hydraulic excavator 5 total cycle time								
Elev	Zones 1 and 2 and foundation		Efficiency	24	-inch lift	Excavation		2 shift	Daily Production	Elev	Zones 3 and 4 and foundation		Efficiency	24	-inch lift	Excavation		2 shift	Daily Production
(feet)	Area	Volume	Factor	# of Lifts	Avg Vol/lift	per lift	total	total	Rate	(feet)	Area	Volume	Factor	# of Lifts	Avg Vol/lift	per lift	total	total	Rate
	(ft2)	(cy)	(%)		(cy)	(hrs)	(hrs)	(days)	(cy/day)		(ft2)	(cy)	(%)		(cy)	(hrs)	(hrs)	(days)	(cy/day)
450	186631									450	76042								
430	120110	113608	90%	10	11361	23.0	230.1	11.5	9872.9	430	50354	46813	80%	10	4681	10.7	106.7	5.3	8775.9
410	62986	67813	80%	10	6781	15.5	154.5	7.7	8775.9	410	30419	29916	70%	10	2992	7.8	77.9	3.9	7678.9
400	29859	17194	70%	5	3439	16.5	82.6	4.1	4163.5										
390	0	5529	60%	5	1106	6.2	31.0	1.5	3568.7	390	0	11266	60%	10	1127	6.3	63.1	3.2	3568.7

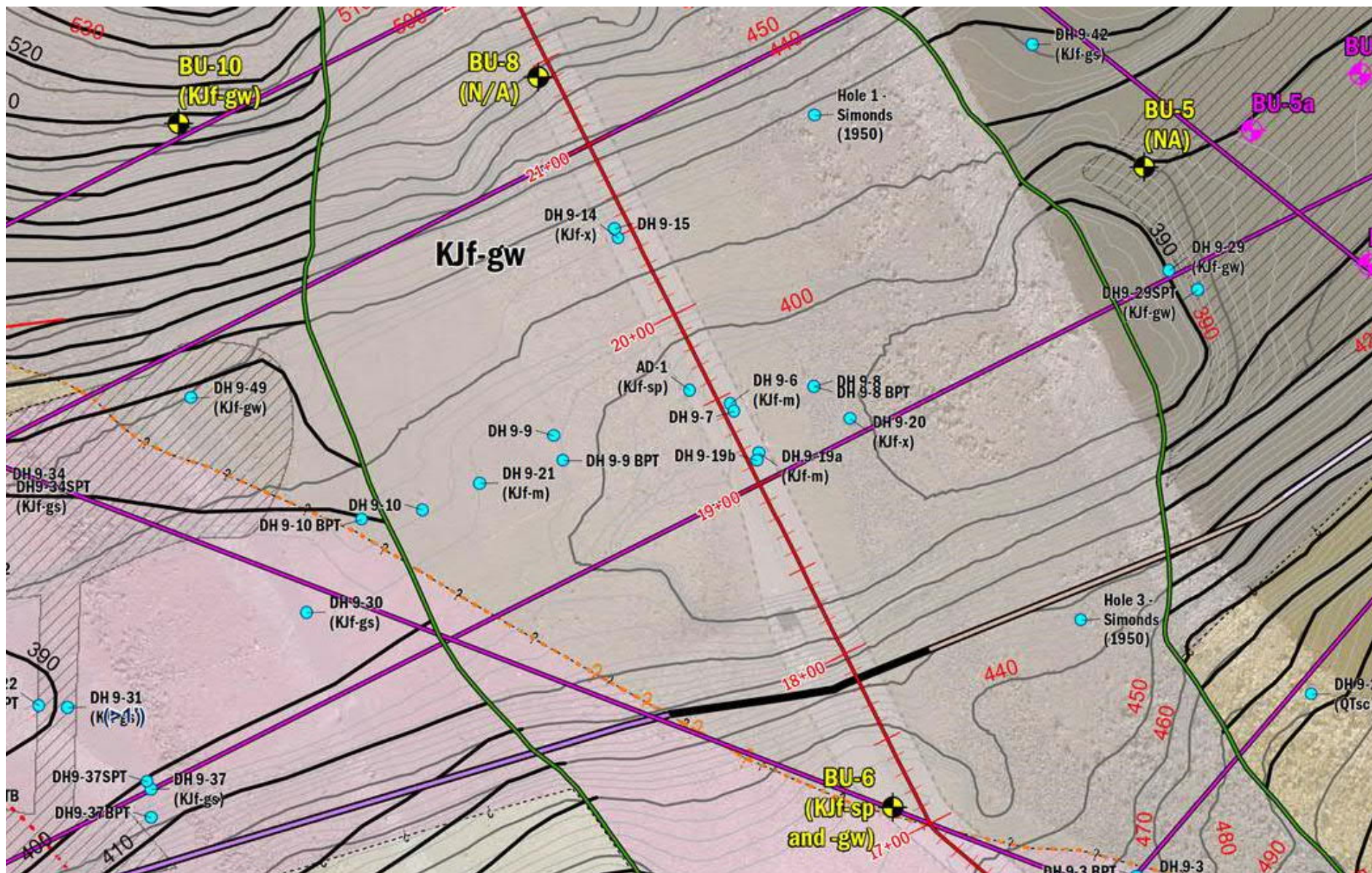
Table B-3 - ANALYSIS OF STAGE 1B FILL(5/20/2021)													
	UPSTREAM BUTRESS												
	Equipment												
	20.4 CY Articulated Trucks to El. 410 (Assumes 28.5 cy loose loads with 1.4 factor)												
	7.8 minute cycle time for trucks to move material from SA-C to fill												
	Bulldozer to Spread												
	2.5 mph average speed for 12T Roller compacting (controlling roller)												
	6 passes												
	6 foot effective drum width												
	0.9 Efficiency factor												
	2 Number of 12T rollers above El. 410												
	3 Number of 12T rollers above El. 430												
	2 Number of bulldozers above El. 430												
	29.3 CY Rigid Body Trucks above El. 410 (assumes 41 cy loose loads with 1.4 factor)												
Elev	Zone 1 and foundation		Efficiency	16	-inch lift	Placement	Compaction			2 shift	cumulative	cum. fill	Total Fill
	Area	Volume	Factor	# of Lifts	Avg Vol/lif	per lift	total	per lift	total	total			Rate
(feet)	(ft2)	(cy)	(%)		(cy)	(hrs)	(hrs)	(hrs)	(hrs)	(days)	(days)	(CY)	(CY/day)
390	0												
400	11079	2052	60%	7.5	274	2.9	21.8	1.4	10.5	1.6	1.6	2051.7	1269.3
410	24253	6543	65%	7.5	872	8.6	64.3	2.8	21.2	4.3	5.9	8594.6	1530.8
430	55157	29411	70%	15	1961	17.9	268.3	3.0	44.8	15.7	21.5	38005.7	1878.8
450	128347	67964	75%	15	4531	13.4	201.1	4.3	64.8	13.3	34.8	105970.2	5111.0

TABLE B-4 - SUMMARY OF ANALYSIS OF STAGE 2B FILL ON UPSTREAM SIDE OF DAM (5/20/2021)											
	Zone 7/8/5A					Zone 5					Total Fill Rate
Elevation	per lift	total	2 shift total	cumulative	cum. fill	per lift	total	2 shift total	cumulative	cum. fill	
(feet)	(hours)	(hours)	(days)	(days)	(CY)	(hours)	(hours)	(days)	(days)	(CY)	(CY/day)
390											
400	1.0	9.9	0.6	0.6	443	10.7	106.6	5.9	5.9	5087	934
403	3.0	9.9	0.6	1.1	797	20.4	61.2	3.4	9.3	8602	1139
408	5.9	33.1	1.8	2.9	1837	27.5	137.6	7.6	17.0	16465	1164
410	8.4	16.8	0.9	3.9	2430	27.2	54.4	3.0	20.0	20290	1462
430	10.4	231.8	12.9	16.8	16624	13.6	272.3	15.1	35.1	73909	4483
450	18.9	430.9	23.9	40.7	48730	15.7	313.5	17.4	52.5	155411	6523

TABLE B-5 - ANALYSIS OF STAGE 2B FILL ON UPSTREAM SIDE OF DAM (5/20/2021)																															
	ZONE 5 (SHELL)										ZONE 7 (CORE)										ZONE 5A (TRANSITION) AND ZONE 8 (FILTER)										
	Equipment 20 CY Articulated Trucks to El. 410 (Assumes 28.5 cy loose loads with 1.4 factor) 7.8 minute cycle time for trucks to move material from SA-C to fill Bulldozer to Spread 2.5 mph average speed for 12T Roller compacting (controlling roller) 6 passes 6 foot effective drum width 2 Number of 12T rollers above El. 410 3 Number of 12T rollers above El. 430 2 Number of bulldozers above El. 410 29 CY Rigid Body Trucks above El. 410 (assumes 40 cy loose loads with 1.4 factor)										Equipment 4 CY Loader to place to El. 410 4 minute cycle time for loader to move material from local stockpile to fill D6 Bulldozer to Spread 2.5 mph average speed for 12T Roller compacting to El. 410 8 passes 6 foot effective drum width 9.3 minute cycle time for truck to move material from RDA to fill 22 CY Articulated Trucks to El. 410 (Assumes 28.5 cy loose loads with 1.3 factor) 5 mph average speed for 825 Roller compacting										Equipment 4 CY Loader to place 4 minute cycle time for loader to move material from local stockpile to fill D6 Bulldozer to Spread 2.5 mph average speed for 12T Roller compacting 4 passes 6 foot effective drum width										
	Zone 5		Efficiency	12	-inch lift	Placement		Compaction		Zone 7				Efficiency	10	-inch lift	Placement		Compaction		Zone 8 and Zone 5A				Efficiency	12	-inch lift	Placement		Compaction	
Elev	Area	Volume	Factor	# of Lifts	Avg Vol/lif	per lift	total	per lift	total	Length	Width	Avg. Area	Volume	Factor	# of Lifts	Avg Vol/lif	per lift	total	per lift	total	Length	Width	Avg. Area	Volume	Factor	# of Lifts	Avg Vol/lift	per lift	total	per lift	total
(feet)	(ft2)	(cy)	(%)		(cy)	(hrs)	(hrs)	(hrs)	(hrs)	(ft)	(ft)	(ft2)	(cy)	(%)		(cy)	(hrs)	(hrs)	(hrs)	(hrs)	(ft)	(ft)	(ft2)	(cy)	(%)		(cy)	(hrs)	(hrs)	(hrs)	(hrs)
390	0									0		0									--	--	0	0							
400	27469	5087	50%	10	509	6.5	65.0	4.2	41.6	160	7	178	33	50%	0	0	0.0	0.0	0.0	0.0	--	--	2212	410	80%	10	41	0.9	8.5	0.1	1.4
403	35809	3515	50%	3	1172	15.0	44.9	5.4	16.3	175	7	1268	80	50%	4	20	0.7	2.7	0.3	1.0	--	--	2730	275	80%	3	92	1.9	5.7	0.2	0.5
408	49105	7862	50%	5	1572	20.1	100.4	7.4	37.2	200	21	3736	463	50%	6	77	2.6	15.4	0.8	4.5	--	--	3488	576	80%	5	115	2.4	12.0	0.2	1.1
410	54182	3825	60%	2	1913	20.4	40.7	6.8	13.7	210	26	4988	323	60%	2	162	4.5	9.0	0.8	1.7	--	--	3816	271	80%	2	135	2.8	5.6	0.2	0.5
430	90590	53619	70%	20	2681	8.7	174.3	4.9	98.0	245	38	23190	10436	70%	24	435	4.4	105.4	1.7	40.2	--	--	6330	3758	80%	20	188	3.9	78.3	0.4	8.0
450	129465	81502	80%	20	4075	11.6	231.8	4.1	81.7	280	50	49424	26894	80%	24	1121	9.9	237.7	3.1	74.9	--	--	7742	5212	80%	20	261	5.4	108.6	0.5	9.8

TABLE B-6 - SUMMARY OF ANALYSIS OF STAGE 2B FILL ON DOWNSTREAM SIDE OF DAM (5/20/2021)																	
	Zone 8/9/5A (upstream 2/3 of blanket)					Zone 7					Zone 5					Maximum Days	Total Fill Rate
Elevation	per lift	total	2 shift total	cumulative	cum. fill	per lift	total	2 shift total	cumulative	cum. fill	per lift	total	2 shift total	cumulative	cum. fill		
(feet)	(hours)	(hours)	(days)	(days)	(CY)	(hours)	(hours)	(days)	(days)	(CY)	(hours)	(hours)	(days)	(days)	(CY)	(days)	(CY/day)
380																	
390	7.6	75.7	4.2	4.2	7547	0	0	0.0	0.0	0	0	0	0.0	0.0	0	4.2	1795
400	12.5	124.8	6.9	11.1	20850	0	0	0.0	0.0	0	0	0	0.0	0.0	0	6.9	1919
410	23	229.5	12.8	23.9	44389	0.6	7	0.4	0.4	243	0	0	0.0	0.0	0	12.8	1865
416	31.6	189.7	10.5	34.4	64883	2.6	18.4	1.0	1.4	923	0	0	0.0	0.0	0	10.5	2009
425	9.0	80.6	4.5	38.9	73883	6.2	67.8	3.8	5.2	3769	16.3	97.8	5.4	5.4	7567	5.4	3573
430	7.9	39.5	2.2	41.1	78225	3.3	19.7	1.1	6.3	6502	11.3	101.5	5.6	11.1	15053	5.6	2582
450	8.1	162.9	9.1	50.2	95906	7.8	187	10.4	16.7	30455	52.8	263.9	14.7	25.7	41053	14.7	4613

TABLE B-7 (PART 2) - ANALYSIS OF STAGE 2B FILL ON DOWNSTREAM SIDE OF DAM (5/20/2021)																					
	ZONE 8/9/5A (FILTER/DRAIN) BLANKET PLACEMENT WITH LOADERS											ZONE 5 (SHELL)									
	Equipment 14 CY Highway Legal Trucks to place above El. 416; zones 12' to 30' 5 minute cycle time for loader to move material from local stockpile to fill D6 Bulldozer to Spread 2.5 mph average speed for 12T Roller compacting 4 passes 6 foot effective drum width											Equipment 20 CY Articulated Trucks above El. 416 (assumes 28.5 cy loose loads with 1.4 factor) 9.3 minute cycle time for trucks to move material from SA-C to fill Bulldozer to Spread 2.5 mph average speed for 12T Roller compacting (controlling roller) 6 passes 6 foot effective drum width									
	Zone 8/9 above valley bottom blanket				Efficiency	12	-inch lift	Placement		Compaction		Zone 5		Efficiency	12	-inch lift	Placement		Compaction		
Elev	Length	Width	Avg. Area	Volume	Factor	# of Lifts	Avg Vol/lift	per lift	total	per lift	total	Area	Volume	Factor	# of Lifts	Avg Vol/lif	per lift	total	per lift	total	
(feet)	(ft)	(ft)	(ft2)	(cy)	(%)		(cy)	(hrs)	(hrs)	(hrs)	(hrs)	(ft2)	(cy)	(%)		(cy)	(hrs)	(hrs)	(hrs)	(hrs)	
380																					
390																					
400																					
410																					
416	30000											0									
425	24000				9000	80%	9	1000	7.4	67.0	1.5	13.6	45400	7567	80%	6	1261	12.0	72.0	4.3	25.8
430	22898				4342	80%	5	868	6.5	32.3	1.4	7.2	35451	7486	80%	9	832	7.9	71.3	3.4	30.2
450	24841				17681	80%	20	884	6.6	131.6	1.6	31.4	34748	26000	80%	5	5200	49.5	247.5	3.3	16.5



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Excerpt from Site Geologic
Map (URS, 2016) Showing
Valley Bottom Contours

Figure
B-1



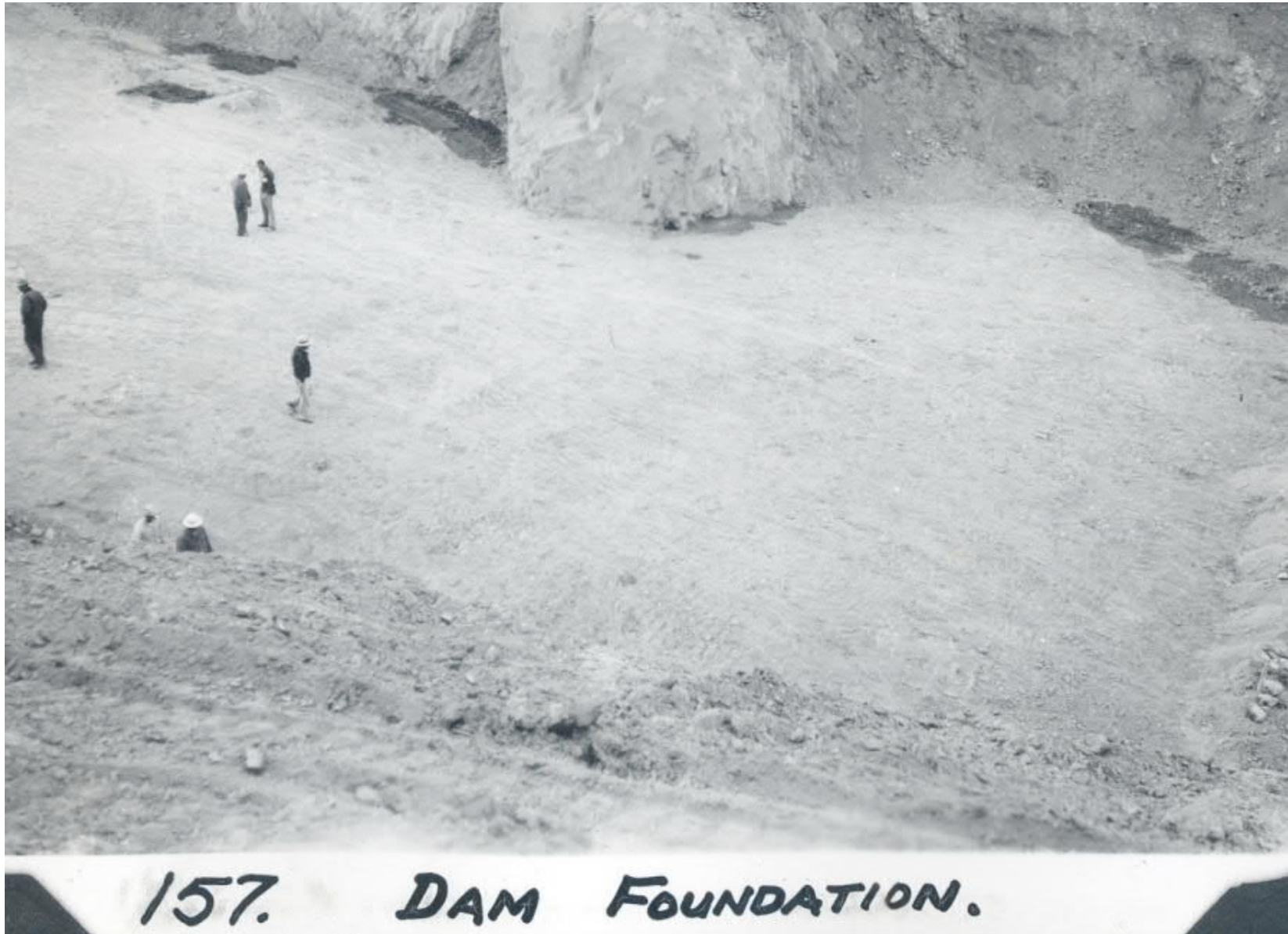
156. STATE INSPECTION OF FOUNDATION.

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Core Foundation in Valley
Bottom from Upstream

Figure
B-2



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Core Foundation in Valley
Bottom from Left Abutment

Figure
B-3



**158. (KELLY ENGEL & BOB JANSON)
EXAMINATION OF ROCK RIB .**

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Core Foundation in Valley
Bottom from Downstream Left
Abutment

Figure
B-4



160. FIRST LOAD OF EARTH FILL.

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Initial Core Material Placement
in Low Area of Valley Bottom

Figure
B-5



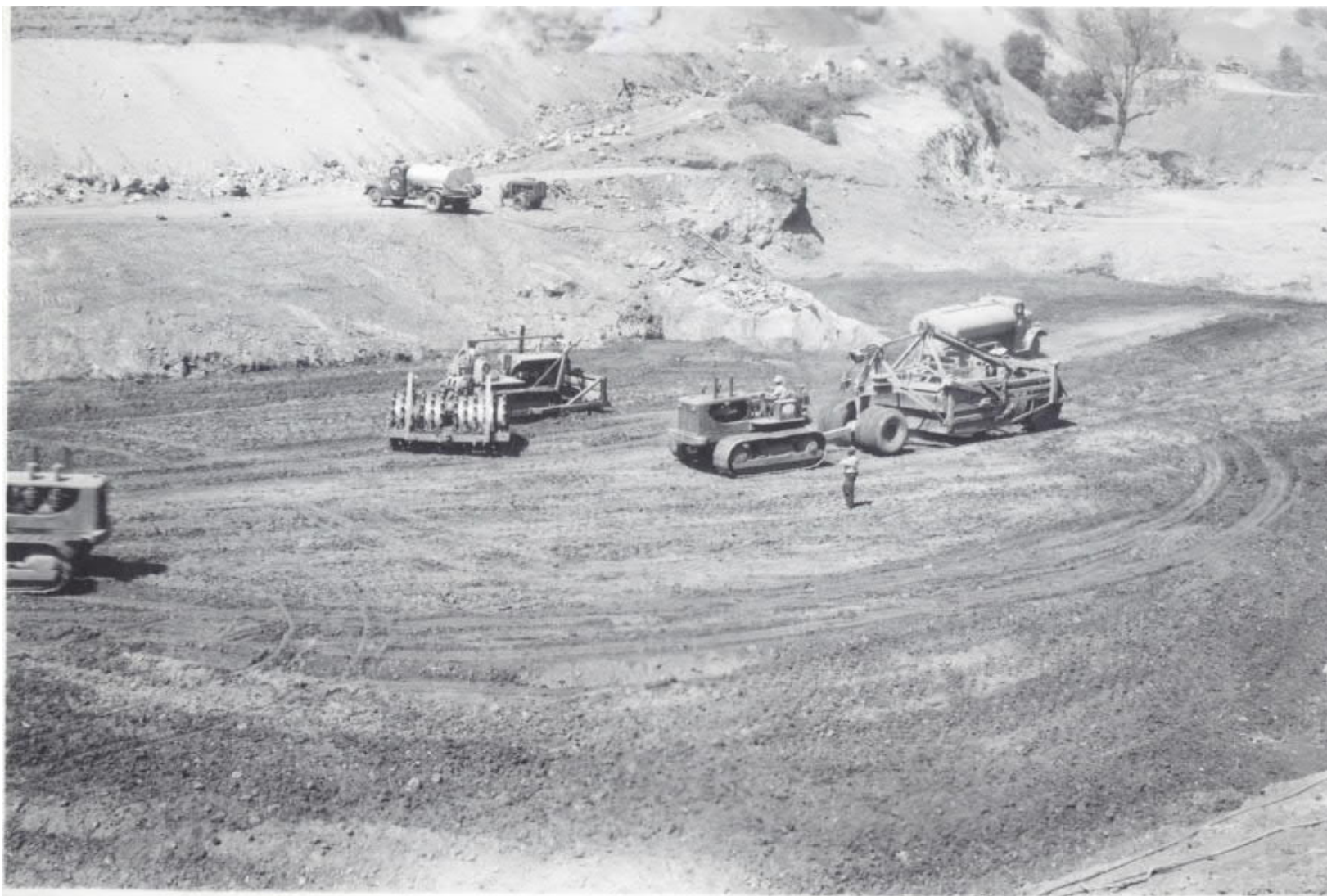
161. FIRST ROLLING.

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URS

Compaction of Initial Core
Material Placed in Low Area of
Valley Bottom

Figure
B-6



162. FILL RISING.

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Low Area in Valley Bottom
Nearly Filled in With Core
Material from Left Abutment

Figure
B-7



163.

SAME.

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Low Area in Valley Bottom
Nearly Filled in With Core
Material from Downstream

Figure
B-8



172. LAST DAYS OF THE BRIDGE.

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Bridge from Left Abutment

Figure
B-9



173. ILLFATED BRIDGE.

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Bridge from Downstream

Figure
B-10



174. FILL HOLES IN DECK.

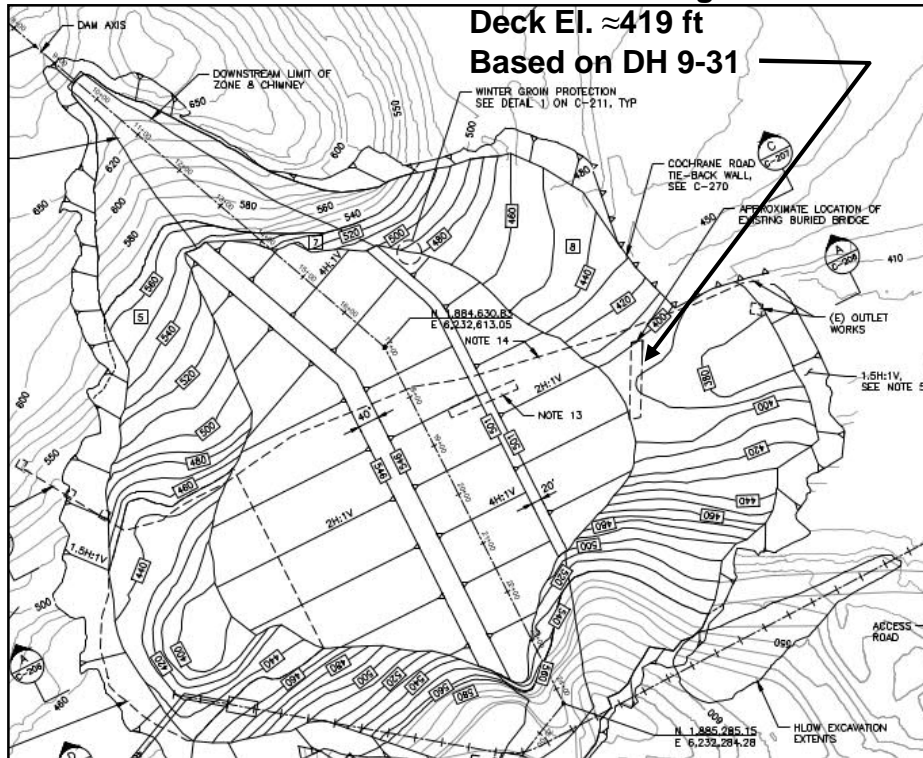
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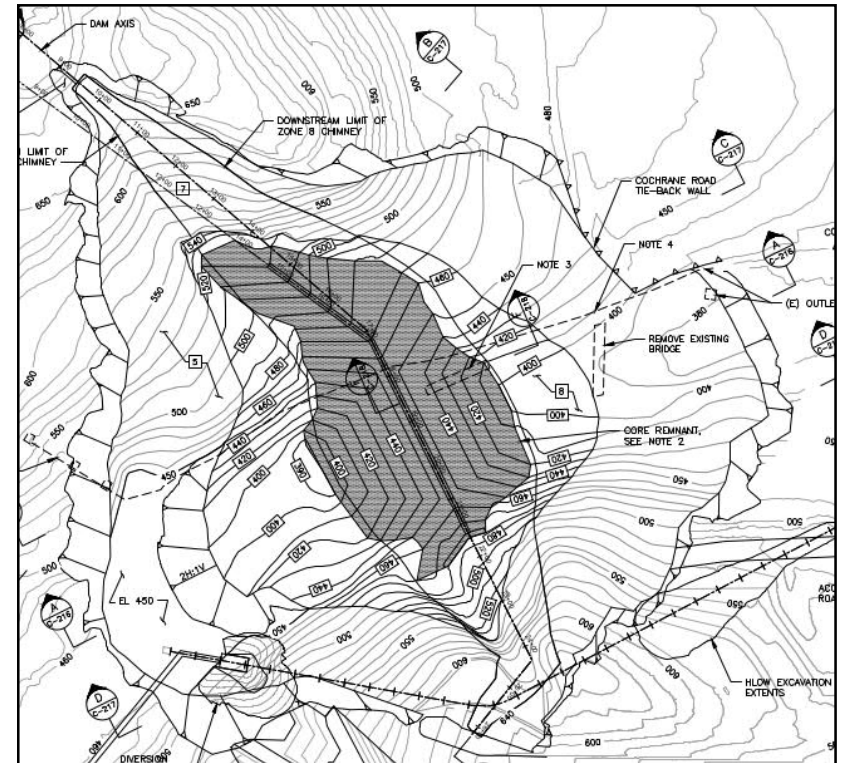
Bridge Deck with Holes for
Placing Fill Below Bridge

Figure
B-11

**Estimated Bridge
Deck El. ≈419 ft
Based on DH 9-31**



End Stage 1b Excavation
excerpted from C-205 (URS 2021)



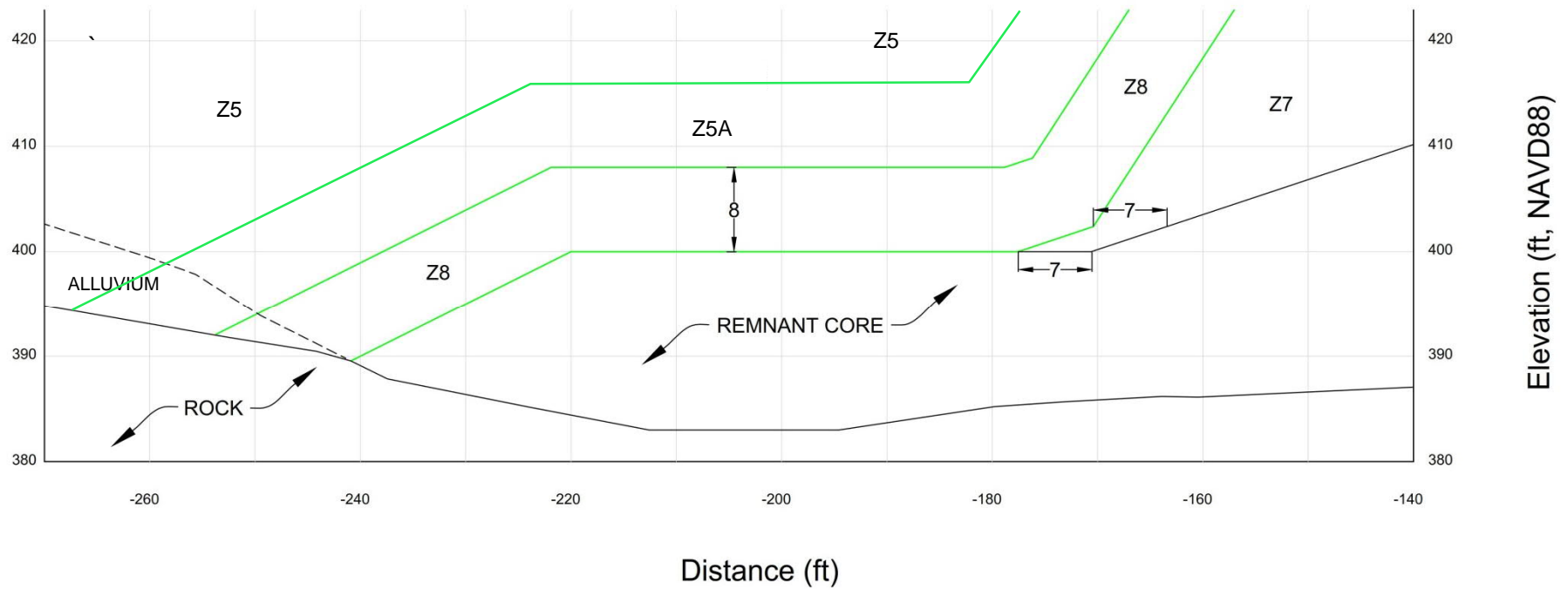
End Stage 2a Excavation
excerpted from C-215 (URS 2021)

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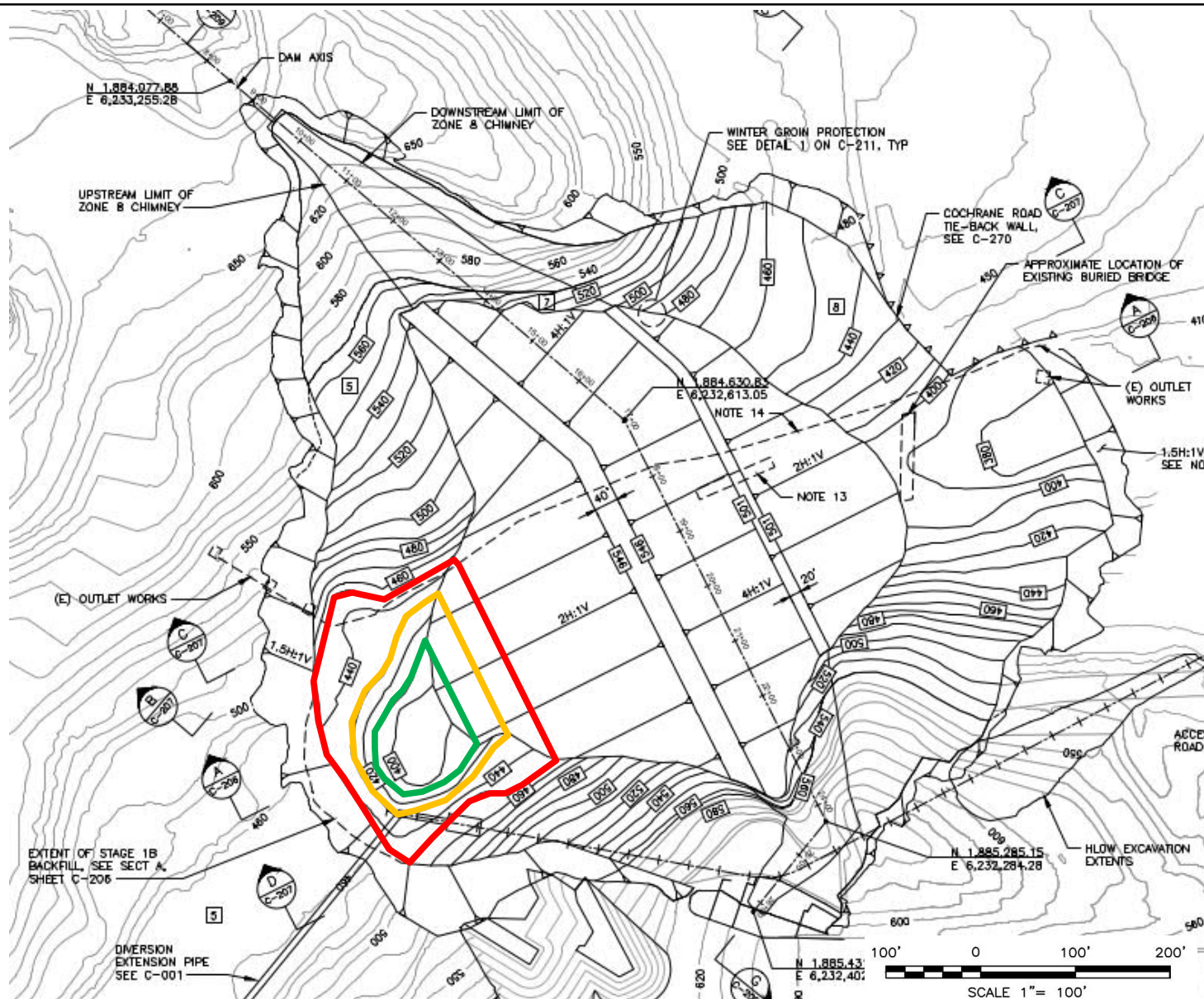
URS

Bridge to be Demolished
During Stage 1b Excavation

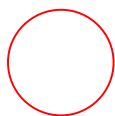
Figure
B-12



ADSRP 26818793	Upstream Remnant Core Detail at Station 19+00	Figure B-13
URS		



Machine Turning
Clearance Circles



CAT 773



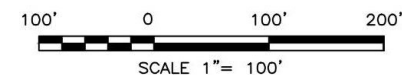
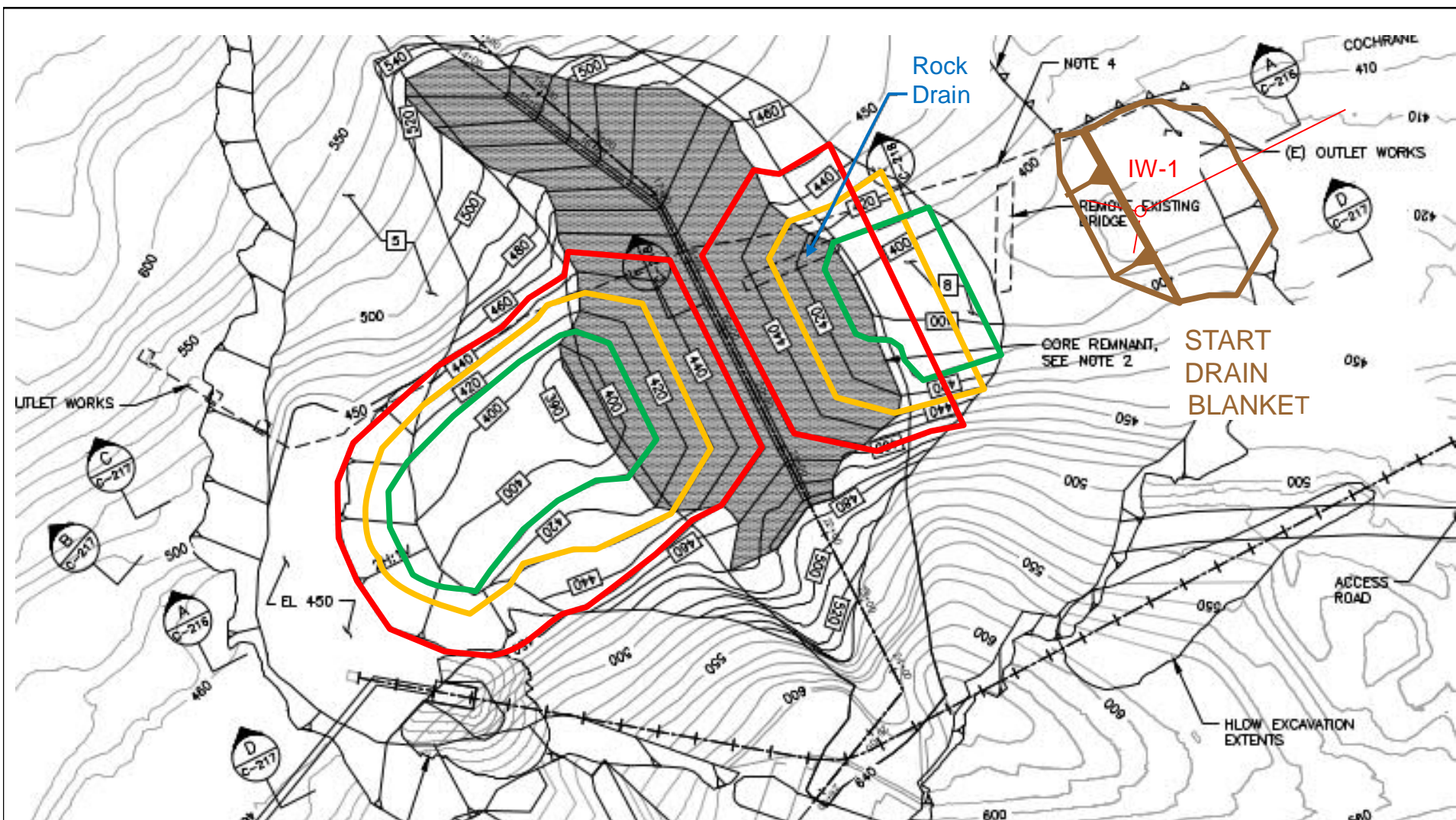
CAT 740

ADSRP
26818793

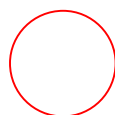
URS

Stage 1b Fill Area
Below El. 450 Feet

Figure
B-15



Machine Turning
Clearance Circles



CAT 773



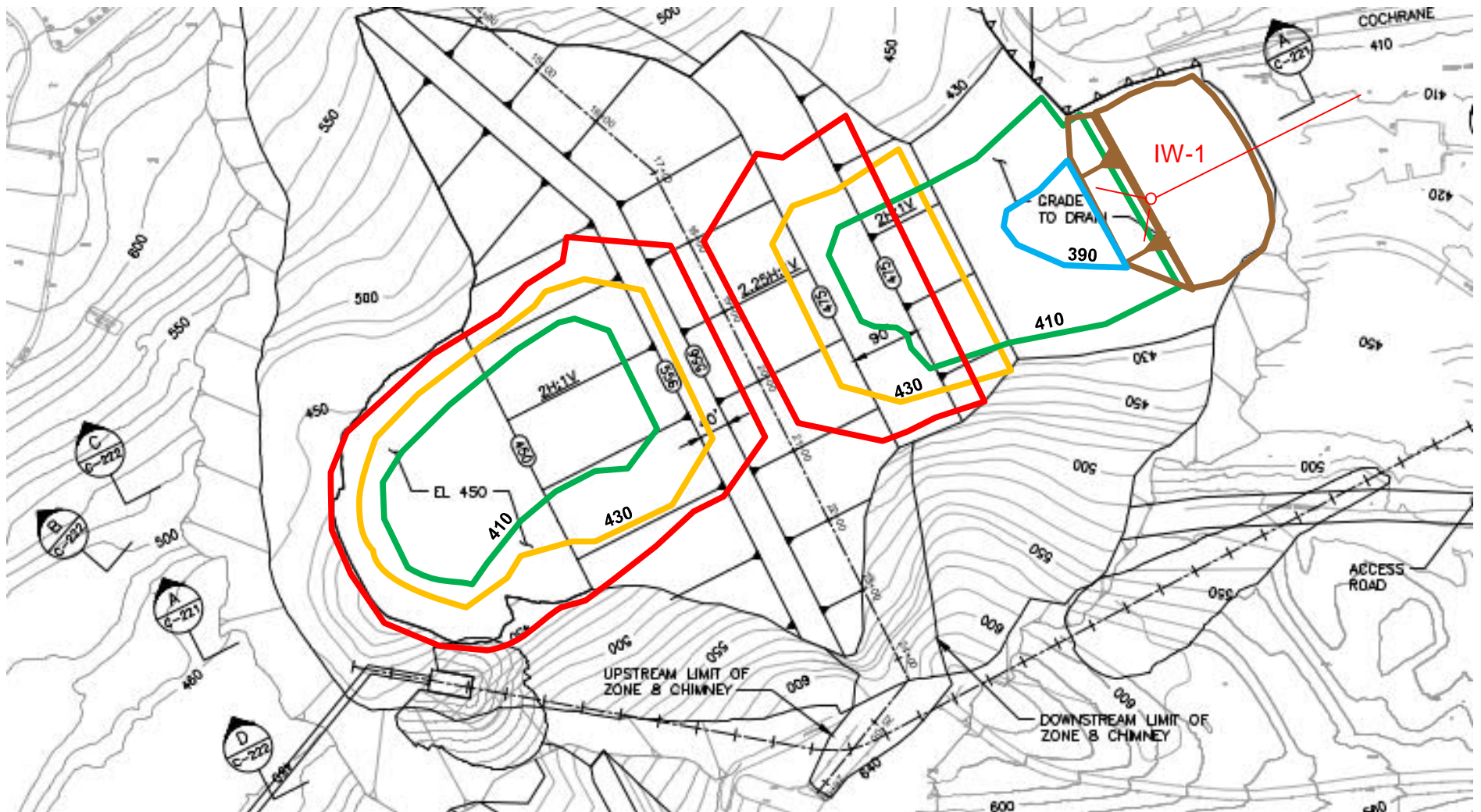
CAT 740

ADSRP
26818793

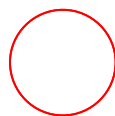
URS

Stage 2a Excavation Areas
Below El. 450 Feet

Figure
B-16



Machine Turning
Clearance Circles



CAT 773



CAT 740

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Stage 2b Fill Areas Below El.
450 Feet

Figure
B-17

